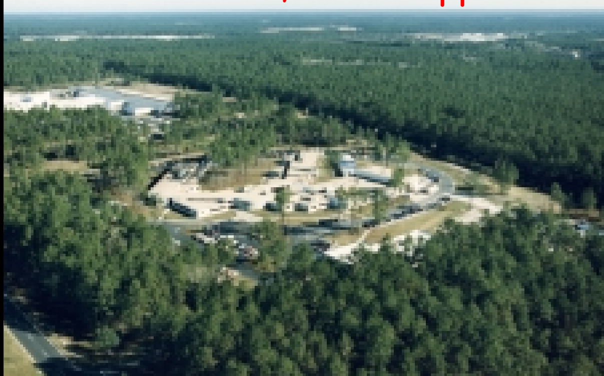
NAVAL RESEARCH LABORATORY'S

FSD, Patuxent River, MD

NRL-DC, Washington, DC

NRL-SSC, Mississippi



Ex-USS *Shadwell*, Mobile, AL

NRL-MRY, Monterey, CA

CBD, Randall Cliff, MD

2001

MAJOR FACILITIES

CONTENTS

2001 NRL MAJOR FACILITIES

- Infrared Range Facility
- IRCM Techniques Laboratory
- Missile Warning System Facility
- Focal Plane Array Evaluation Facility
- Fiber Optic Optical-Microwave Laboratory
- Fiber-Optic Sensor Facility
- Oxide Optical Fiber Fabrication Facility

Code 5700 – Tactical Electronic Warfare Division

- Visualization Laboratory
- Off-Board Test Platform
- Transportable Radar Cross Section Measurement Radar
- Vehicle Development Laboratory
- Advanced Tactical Electronic Warfare Environment Simulator
- Mobile ESM Laboratory
- Compact Antenna Range Facility
- Isolation Measurement Chamber Facility
- Millimeter Wave Anechoic Chamber Facility
- Low-Power Anechoic Chamber
- Search Radar ECM/EA Simulator
- Electro-Optics Mobile Laboratory
- Infrared/Electro-Optical Calibration and Characterization Laboratory
- Infrared Missile Simulator and Development Laboratory
- Scale Model Analysis Facility
- Secure Supercomputing Facility
- Central Target Simulator Facility
- Flying Electronic Warfare Laboratory

MATERIALS SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE

Code 6030 – Laboratory for Structure of Matter

- Automatic X-ray Diffractometers
- Atomic Force Microscope

Code 6100 – Chemistry Division

- Chemical Analysis Facility
- Corrosion Engineering and Coatings Characterization Facilities
- Marine Corrosion Facility
- Nanometer Characterization/Fabrication Facility
- Synchrotron Radiation Facility
- Ex-USS *Shadwell* Advanced Fire Research Ship

- Fire Research Enclosure
- Fire Research Test Bed
- Large-Scale Damage Control Facility

Code 6300 – Materials Science and Technology Division

- Computer-Controlled Universal Material Test System
- Materials Processing Facility
- Mechanical and Thermal Experimental Facilities
- High-Power Microwave Facility
- Ion Implantation Facility
- 3-MV Tandem Van de Graff Accelerator

Code 6400 – Laboratory for Computational Physics and Fluid Dynamics

- Parallel High Performance Computer Graphics Facility

Code 6700 – Plasma Physics Division

- Nike KrF Laser Facility
- Electra Laser Facility
- Large Area Plasma Processing Systems
- Space Physics Simulation Chamber
- Gamble II
- Hawk
- Long Pulse Accelerator Laboratory
- High-Frequency Microwave Processing of Materials Laboratory
- Pharos Laser System
- T-Cubed Laser System

Code 6800 – Electronics Science and Technology Division

- Nanoelectronics Processing Facility
- Ultrafast Laser Facility
- Space Solar Cell Characterization Laboratory
- Vacuum Electronics Fabrication Facility
- Compound Semiconductor Processing Facility
- The MOCVD Laboratory
- Epicenter for Advanced Materials Growth and Characterization

Code 6900 – Center for Biomolecular Science and Engineering

- Advanced Microscopy Facility
- Liquid Crystal Fabrication Facility

OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE

Code 7100 – Acoustics Division

- Acoustic Communications Measurement System
- Instrumentation Suite for Making Measurements of Acoustic Propagation in Complex Shallow Water
- Structural Acoustics In-Air Facility
- Laboratory for Structural Acoustics
- Shallow Water Acoustic Laboratory
- Multichannel Acoustic Data Processing Laboratory
- Autonomous Acoustic Receiver System
- Salt Water Tank Facility
- Tactical Oceanography Simulation Laboratory and Wide Area Network
- Shallow-Water High-Frequency Measurement Systems

Code 7200 – Remote Sensing Division

- Optical Spectral Measurements Facility
- Naval Prototype Optical Interferometer (NPOI)
- Free Surface Hydrodynamics Laboratory

Code 7300 – Oceanography Division

- Environmental Microscopy Facility
- Ocean Dynamics and Prediction Network
- Visualization Laboratory
- Littoral Current Measurement Facility
- Scanning Slope Sensing and Wave Gauge Array Buoy
- Salinity Temperature and Roughness Remote Scanner
- Ocean Color Facility
- Ocean Optics Instrumentation Systems

Code 7400 – Marine Geosciences Division

- Electron Microscopy Center
- Sediment Physical and Geoacoustic Properties and Sediment Biogeochemistry Laboratories
- Moving-Map Composer Facility

Code 7500 – Marine Meteorology Division

- Satellite Data Ingest and Processing System
- Meteorological Computing and Archival Facility
- John B. Hovermale Modeling, Database, and Visualization Laboratory

Code 7600 – Space Science Division

- Cryogenic Sensor Test Facility
- Vacuum Ultraviolet Calibration/Testing Facility
- Solid-State Position-Sensitive Detector Evaluation Facility
- Large Angle and Spectrometric COronagraph
- Rocket Assembly and Checkout Facility
- Solar Coronagraph Optical Test Chamber
- Space Instrument Test Facility

NAVAL CENTER FOR SPACE TECHNOLOGY

Code 8100 – Space Systems Development Department

- Precision Radio Frequency Anechoic Chamber Facility
- Satellite Mission Analysis Facility
- Radio Frequency Anechoic Chamber Facility
- Midway Research Center Precision Spacecraft Calibration Facility
- Blossom Point Satellite Tracking and Command Station
- Precision Clock Evaluation Facility

Code 8200 – Spacecraft Engineering Department

- Modal Survey Test Facility
- Static Loads Test Facility
- Spacecraft Vibration Test Facility
- Payload Processing Facility
- Thermal Vacuum Test Facility
- Spacecraft Acoustic Reverberation Chamber Test Facility
- Spacecraft Spin Test Facility
- Reshape Facility
- Spacecraft Thermal Analysis, Fabrication, and Test Facility
- NCST Composite Materials Laboratory
- Spacecraft Robotics Engineering and Controls Laboratory
- Class 100 Clean Room Facility

GENERAL INFORMATION

- Maps
- Key Personnel

EXECUTIVE DIRECTORATE

Code 1600 – Patuxent River Flight Support Detachment

- Flight Support Detachment

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Flight Support Detachment

Research Platforms

FUNCTION: Operates and maintains a fleet of five uniquely configured, research modified NP-3D Orion aircraft used to support a wide spectrum of projects and experiments. The officer-in-charge of the Flight Support Detachment and his assistant are responsible for setting policy, scheduling aircraft assets, and managing the daily activities of the Detachment.

DESCRIPTION: Located on the western shore of the Chesapeake Bay at Naval Air Station, Patuxent River, Maryland, the Flight Support Detachment encompasses a 15,900-ft^2 aircraft hangar, a 5,600-ft^2 Executive and Operations Headquarters building, three research projects facilities buildings, three storage buildings, and one aircraft movement support facility. The Naval Air Station provides two runways and a large number of aircraft support services.

Research assets include five NP-3D Orion aircraft configured to perform numerous airborne research projects, including bathymetry, electronic countermeasures, gravity mapping, and radar development research. Included in the inventory is the Navy's first Rotodome P-3 aircraft and the oldest P-3 Orion still on active duty.

CONTACT:
CDR T. Munns • Code 1600 • (301) 342-3751
LOCATION:
Flight Support Detachment • Naval Air Station, Patuxent River, MD

BUSINESS OPERATIONS DIRECTORATE

Code 3000 – Business Operations Directorate
- Chesapeake Bay Detachment

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Chesapeake Bay Detachment (CBD)

Chesapeake Bay Detachment field site

FUNCTION: Operates and maintains a unique land, sea, and air facility for NRL research. It has a variety of plant facilities and specialized equipment to support NRL and tenant research and development projects.

INSTRUMENTATION: The principal investigator is responsible for all instrumentation and test equipment.

DESCRIPTION: The main site at Randle Cliff (Chesapeake Beach), MD, covers 157.4 acres contiguous to the Chesapeake Bay with a 0.75-mile waterfront. It is located in a relatively clear area away from congestion and industrial interference. In addition to six moderate-size laboratory buildings, there are several new structures. The facility maintains towers for antenna support and a ship motion simulator for dynamic testing of components. Off-site facilities include a 2-acre site with a 75-ft tower located 10 nmi east at Tilghman Island, MD, and small-craft berthing located in the town of Chesapeake Beach, 2 nmi north of the main site. A test control center for air and sea operations is available to researchers who use the NRL/CBD test range. The test range is a restricted zone directly east of the main site and extends across the bay.

Research watercraft include a 74-ft LCM-8, a 65-ft Adams support craft, a 36-ft LCPL, and a 22-ft Boston Whaler. These are used primarily in support of research projects and secondarily as transport to Tilghman Island.

CONTACT:
T. Downing • Code 3522 • (410) 257-4002

LOCATION:
Chesapeake Bay Detachment • Chesapeake Beach, MD

SYSTEMS DIRECTORATE

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Technical Information Division

- Video Teleconferencing
- NRL Auditoriums
- Ruth H. Hooker Research Library

Video Teleconferencing (VTC)

Video teleconferencing facility in Bldg. 226

FUNCTION: Video teleconferencing (VTC) facilities enable verbal and visual communication between NRL staff and up to three other locations that use standards-based VTC systems. VTC allows you to disseminate information without spending time, money, and energy in getting from place to place.

INSTRUMENTATION: Audio/video features of the LC5000 Advanced Conferencing System are two 36-in. monitors, a smart-track dual camera system, continuous presence viewing capability, StandardsPlus video, 384 kbps rate, 30-frames per second video, PIP, still image capture, duplex audio with adaptive echo cancellation, VCR support, integrated PC sound, a document camera with SmartView software, internet capability, Pen Pal Graphics slide presentation and annotation, and wireless keyboard and mouse. This system also has connectivity to NRL auditoriums and the NRL television network.

DESCRIPTION: NRL's two VTC facilities are equipped with the latest technologies. The facility in Bldg. 226 accommodates 30 people and can communicate with up to three other sites. In this facility, you can use a Mac or PC to display computer-generated graphics; you can display hard copy, transparencies, and small 3-D objects; and you can transmit video recordings, show slides, and video record ongoing conferences. A Fax machine is available at the VTC for your use.

The VTC facility in Bldg. 43 accommodates 8 to 10 people and can communicate with up to 3 other sites. You can display hard copy, transparencies, and small 3-D objects, and you can transmit video recordings and video record ongoing conferences. A fax machine is available for your use.

CONTACT:
R. Bussey • Code 5210.2 • (202) 404-5843
LOCATION:
Bldg. 226, Rm. 111/Bldg. 43, Rm. 218D • NRL, Washington, DC

NRL Auditoriums

Auditorium in Bldg. 60

FUNCTION: Accommodates the symposia needs of the NRL research and support communities.

EQUIPMENT: LCD projectors, TV/VCR, slide projectors, viewgraph projectors, house audio, Mac and/or PC connectivity to electronic display projectors, video and audio recording, broadcasting via NRL broadband cable network and/or video conferencing, kitchens, lobbies, receptions areas, banquet room, and courtyard.

DESCRIPTION: NRL's auditoriums are located in Bldgs. 28, 60, 222 (main auditorium, annex, science lounge with kitchen, and exhibit room), 226 (main auditorium, VTC facility, three breakout rooms, and a banquet room), and Quarters A (with a kitchen). All are equipped with state-of-the-art projection systems that support PCs, Macs, and video. These systems can be used as workstations, and all are networked to support electronic displays. All of the auditoriums have a prefunction area for badging and registration as well as refreshments. Classified meetings may be set up in Bldgs. 28, 60, and all meeting rooms in Bldgs. 222 and 226.

SCHEDULING: Contact Code 5210 at (202) 767-3373.

Auditorium website: http://audserver.nrl.navy.mil.

CONTACT:
R. Bussey • Code 5210.2 • (202) 404-5843
LOCATION:
Bldg. 226, Rm. 111/Bldg. 43, Rm. 218D • NRL, Washington, DC

Ruth H. Hooker Research Library

Digital sender scans library materials and e-mails them as PDF attachments

FUNCTION: Supports NRL and ONR research by linking scientists and administrators with the scientific and technical information they need. Provides a physical facility for study and research, staffed with subject specialists and information professionals to assist researchers in locating and retrieving published information. Develops and catalogs book, journal, and report collections in the areas of NRL research interests. Licenses site access to relevant information that is available digitally and develops mechanisms for delivering it to the desktop.

EQUIPMENT: End-user workstations, photocopiers, color copier/printer, microform reader/printers, and digital scanner/sender. Networked computers for machine-assisted cataloging and interlibrary loan via OCLC (Online Computer Library Center), equipment for digital receipt and transmission of documents using Ariel software, fax machines, DTIC terminals, and SIPRnet connection.

DESCRIPTION: The Library collections focus on physics, chemistry, electronics, and space sciences. They include 150,000 books and journal volumes, 1,000 current journal subscriptions, and 1,825,000 technical reports in paper, microfiche, or electronic format. The contents of the Library's collections are analyzed, so they can be readily identified through a catalog search and are physically organized to facilitate retrieval. Services include: reference assistance in using the collections and locating information from external sources; mediated literature searches of several hundred on-line databases, including classified databases, to produce on-demand subject bibliographies; circulation of materials from the collection, including classified literature up to the Secret level; interlibrary loan to obtain needed items from other scientific and research libraries or from commercial document providers; assistance in ordering journals for office retention; and user education and outreach to help researchers improve productivity through effective use of the physical library and the rapidly growing digital library resources available through InfoWeb, TORPEDO *Ultra*, and the Internet.

CONTACT:
L. Stackpole • Code 5220 • (202) 767-2357
LOCATION:
Bldg. 43, Rms. 300 and 14 • NRL, Washington, DC

Radar Division

- Millimeter Wave Radar Facility
- Radar Imaging Facility
- Radar Signature Calculation Facility
- Airborne Early Warning Radar Facility
- Compact Range Facility
- Airborne Surveillance Command and Control Research Platform
- Radar Test Facility
- Microwave Microscope
- Advanced Technology Chamber

Millimeter Wave Radar Facility

Shelters housing the high-power 94 GHz radar

FUNCTION: Experimental high-power 94 GHz tracking radar system (WARLOC) for use in research involving target cross section measurement, propagation effects, radar imaging, cloud research, and other research that requires very high range and angular resolution.

INSTRUMENTATION: Real-time radar control, signal processing, and image formation are accomplished with a VME-based system. An optical tracking system is mounted on the antenna to help in target acquisition at short range.

DESCRIPTION: The WARLOC radar is housed in a relocatable radar facility that consists of two equipment shelters, a chiller for cooling the transmitter, and a 175 kVA diesel generator for use at remote sites. A 40-ft long shelter houses the transmitter power supply, modulator, and gyro-klystron and incorporates structures to provide a pedestal base for the roof-mounted tracking antenna. A second 20-ft shelter contains the receiver, exciter, signal processing, and recording equipment. Data recording at rates up to 80 MB/s and a capacity of more the 200 GB is available. The transmitter is capable of producing 10 kW of average power with a variety of waveforms suitable for precision tracking and imaging of targets at long range. Waveforms with a bandwidth of 600 MHz can be transmitted at full power. A 6-ft Cassegrain antenna is mounted on a precision pedestal and achieves 62 dB of gain.

CONTACT:

V. Gregers-Hansen • Code 5306 • (202) 404-1925

LOCATION:

Relocatable Facility • Chesapeake Bay Detachment, Chesapeake Beach, MD

Radar Imaging Facility

Radar Imaging Facility Raid Storage System, real-time processor, and VLDS recorder units

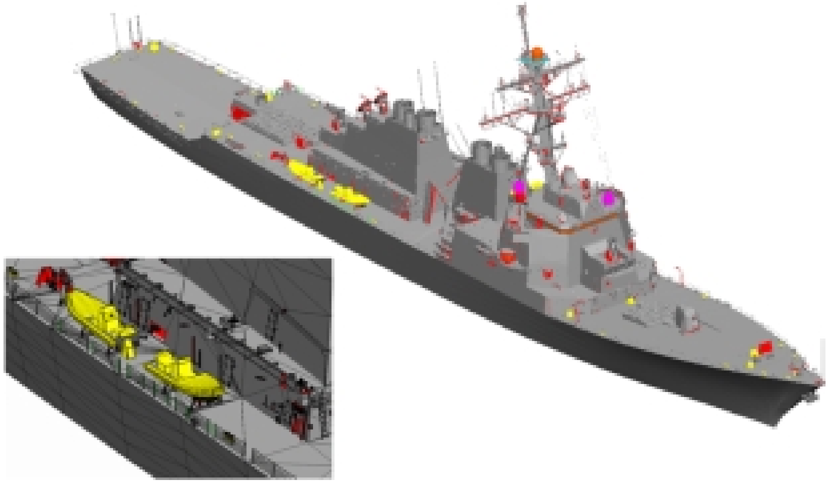
FUNCTION: Provides the capability to produce real-time and nonreal-time radar imagery (SAR and ISAR). This facility contains the processing, data storage, and the image display and recording resources to handle data from a number of platforms and also serves as an environment for the development of advanced imaging algorithms.

EQUIPMENT: The facility provides VLDS data recorders for playback of data tapes and standard video generation and recording capability for the production of live video recordings. Two VME-based systems are available for interfacing other data recorders, custom interfaces, or other VME-based instrumentation.

DESCRIPTION: The Radar Imaging Facility is housed in a secure vault. The general computing resources that are available include three sun workstations, three SGI workstations, and two PC-based workstations (running Linux). In addition, there are two VME-based multiprocessor systems; one system with four I-860 processors and one system with 12 Power-PC processors, which provide real-time processing capability. Data storage is provided by two Raid systems, with a combined storage capacity of 650 GB. All systems are connected by a 100 Mbs network, which also provides connectivity to the other branch facilities. Video scan converters provide the capability to record the video from any of the workstations and real-time processors and a separate video facility provides video editing capabilities.

CONTACT:
R. Lipps • Code 5313 • (202) 404-1979
LOCATION:
Bldg. 60, Rm. 220 • NRL, Washington, DC

Radar Signature Calculation Facility



CAD model of USS *The Sullivans* (DDG-68)

FUNCTION: Calculates, analyzes, and visualizes the spatially extended radar signatures of complex objects such as ships in a sea multipath environment and phased array antennas. Radar signatures that are typically calculated include total radar cross section (RCS), high-range resolution (HRR) profiles, and inverse synthetic aperture (ISAR) images. The facility has been used on numerous Navy programs, including the design and live fire test and evaluation of the DDG-51 and LPD-17 class ships.

INSTRUMENTATION: The facility currently consists of a Silicon Graphics Origin 2400 parallel computer with 24 processors and 24 GB of physical memory, a Silicon Graphics Octane graphics workstation with 2 processors and 2 GB of physical memory, a DEC with 3 processors and 1 GB of physical memory, several smaller UNIX workstations and INTEL x86 computers, and a Motorola network encryption system (NES) for secure communications with other facilities.

DESCRIPTION: The facility consists of several high-performance computers for calculating the radar signatures of complex objects such as ships and phased array antennas. The radar signatures are calculated from computer-aided design (CAD) models that describe the geometry and material properties of objects. The facility currently includes models of the FFG-7, DD-963, DDG-51, CG-47, PC-9, LPD-17, and CVN-68 class ships. A large collection of CAD models of individual ship components such as antennas, weapons systems, and deck equipment is also available. The radar signatures of large objects are calculated using the Radar Target Signature (RTS) model. The RTS model is based on high-frequency scattering techniques and was developed by the Radar Division specifically for calculating the radar signature of ships in a sea multipath environment. The radar signature of smaller objects such as phased array antennas can be accurately calculated using any of several low-frequency, computational EM software packages available within the facility.

CONTACT:
D. Zolnick • Code 5314 • (202) 404-8602
LOCATION:
Bldg. 60, Rm. 214 • NRL, Washington, DC

Airborne Early Warning Radar Facility

Ten-element AAFTE airborne radar array antenna

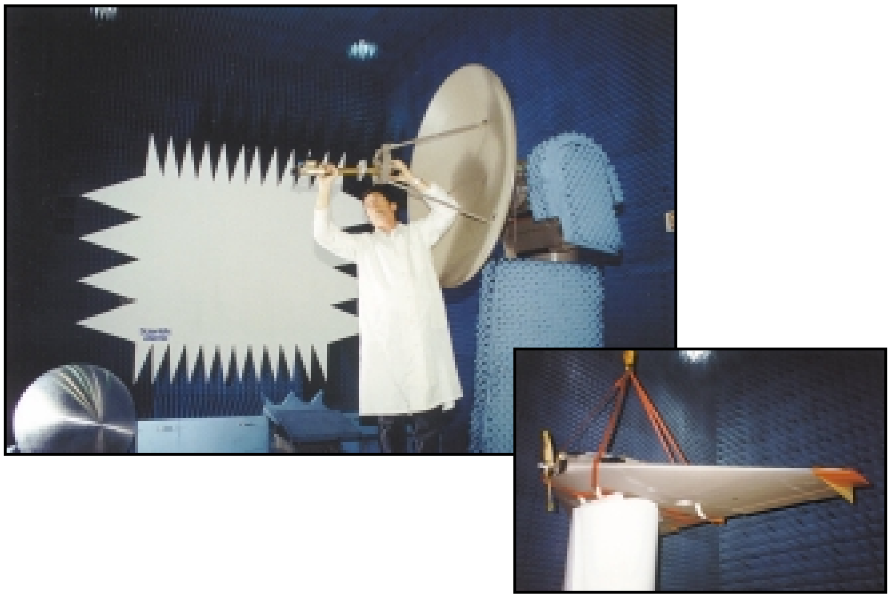
FUNCTION: Collects, reduces, and analyzes airborne radar data and identifes, develops, and evaluates new techniques for improving the performance of airborne radars. Nearly all new techniques require radars employing multi-element, multichannel antenna arrays. Of particular interest is Space Time Adaptive Processing (STAP), a technique for optimizing radar detection performance in the presence of jamming and clutter.

INSTRUMENTATION: Includes an extensively modified APS-125 radar receiver system; the 10-element Adaptive Array Flight Test Equipment (AAFTE) antenna for collecting multichannel airborne array radar data; a rack mounted STAP pre- and post-processor; a simulation and evaluation suite; and three UNIX computer workstations.

DESCRIPTION: The facility includes a data and signal processing laboratory in Bldg. 60, and the 10-element AAFTE airborne radar array antenna and STAP laboratory currently located in Bldg. 56. Data collected using the AAFTE antenna were used in the first successful demonstration of STAP processing.

CONTACT:
S. Schultz • Code 5315 • (202) 404-4436
LOCATION:
Bldg. 60, Rm. 221 • NRL, Washington, DC

Compact Range Facility



Compact Range Facility

FUNCTION: Measures antenna properties and characteristics and performs radar cross section (RCS) measurements of various objects. These data are used to verify and optimize the designs of new or existing platforms.

INSTRUMENTATION: The facility contains an HP 8530 microwave receiver capable of operating from 2-110 GHz, a 5-axis positioner/controller, a pulsed CW system for radar cross section measurements, and a nearfield scanner that is controlled by the MI Technologies Model MI-3000 Automated Measurement System. The compact range data collection is controlled by a FR 959 antenna/RCS software package using two 700 MHz Windows NT computer systems. Off-line RCS imaging (ISAR) is performed using Knowbell System Software.

DESCRIPTION: The facility is jointly operated by the Space Systems Development Department and the Radar Division. It contains a Scientific Atlanta Model 5706M compact range reflector that produces simulated farfield conditions from 1-110 GHz with a quiet zone (maximum usable size) of approximately 7 ft in diameter and 8 ft in length. The compact range reflector system is positioned inside a 20 × 20 × 40-ft room that is lined with microwave absorbing material to reduce internal reflections to a negligible level. The back wall of the chamber (which receives the majority of the energy) is covered with 24-in. and the sides, floor, and ceiling are covered with 12-in. pyramidal shaped absorber. The chamber also includes an 18 × 12 ft nearfield scanner, which can be configured for planar, cylindrical, or spherical nearfield measurements.

CONTACT:
M. Parent • Code 5317 • (202) 767-6277
LOCATION:
Bldg. A59, Rm. 11A1 (Door B) • NRL, Washington, DC

Airborne Surveillance Command and Control (ASC²) Research Platform

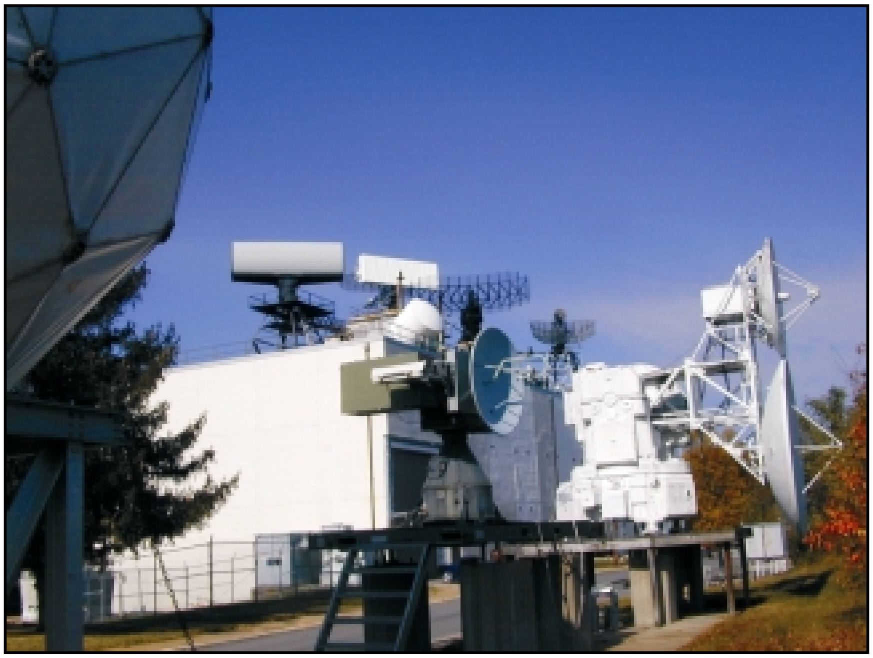
Airborne Surveillance Command and Control (ASC²) research aircraft

FUNCTION: Acts as a surrogate for carrier-based surveillance, engagement, communication relay, combat identification, command and control capable assets of the evolving family of systems warfare architecture. In addition to the integrated AN/APS-145 based AEW/CEC suites, the aircraft is designed to accommodate Command and Control (C²), Electronic Warfare (EW), Radar, and Electro-Optics (EO) research and development (R&D) programs well into the next century.

DESCRIPTION: The NRL Airborne Surveillance Command and Control (ASC²) research aircraft is a NP-3D aircraft integrated with a full E-2C AEW Hawkeye 2000 suite, which includes the full cooperative engagement capability (CEC). This heavyweight P-3B is configured with a Hawkeye 2000 Airborne Early Warning (AEW) system and an Airborne CEC suite to support the Navy's future AEW/CEC Network Centric Warfare programs. In addition to the AEW/CEC installation, there are floor and ceiling rails to accommodate six additional operator/equipment consoles in the aft crew compartment, a free-fall sonobuoy chute, space for mounting up to 700 lb of equipment in the forward equipment area, and cross-decked JTIDS Class II equipment. External wing wiring is installed, including fiber optics to support six external electronic pods. The nose radome area has been fitted for a modified IRDS (Infrared Radiation Detection System) turret that can be lowered and raised to support electro-optic projects. Additional structure mountings are in the nose and tail to accommodate the installation of project antennas. The aircraft can accommodate an additional internal payload of up to 2,800-lb external payloads of up to 10,000 lb and a crew of up to 16 people, including military flight crew and project scientists. The avionics suite includes a state-of-the-art, digitally controlled analog ICS system, dual INS, SATCOM, GPS, seven UHF, four VHF, and two high-power HF communications systems, all of which are secure communications capable and available for project use. Additionally, it is outfitted with four 90 KVA generators, wired to accommodate future growth of two 120 KVA generators.

CONTACT:
W. Barnwell • Code 5318 • (202) 767-3475
LOCATION:
Bldg. 60, Rm. 210 • NRL, Washington, DC

Radar Test Facility



Radar antennas in front of and on the roof of Bldg. 75

FUNCTION: Tests and evaluates basic concepts and engineering developments in connection with target surveillance, tracking, and electronic countermeasures.

INSTRUMENTATION: Current instrumentation includes the SPS-49 radar; the Senrad radar, which uses a wideband array mounted back-to-back with the SPS-50 antenna; the SPS-55 and SPS-64 navigation radars; and antennas for the SPS-40 and SPS-10 radar systems. In front of the building are two precision tracking pedestals that were originally used for the FPS-16 and TPQ-27 radars but now have been modified for research use. Here also are two mobile research radar systems, the EDM version of the SPQ-9B and the engagement radar, an X-band phased array radar.

DESCRIPTION: The Radar Test Facility is on top of the cliff in front of Bldg. 75. Antennas are located on the ground and the roof for the numerous developmental and product-line radar systems. They provide a simulated naval scenario overlooking the Chesapeake Bay. Inside the building are the radar control rooms, transmitters, receivers, and data processing equipment.

CONTACT:

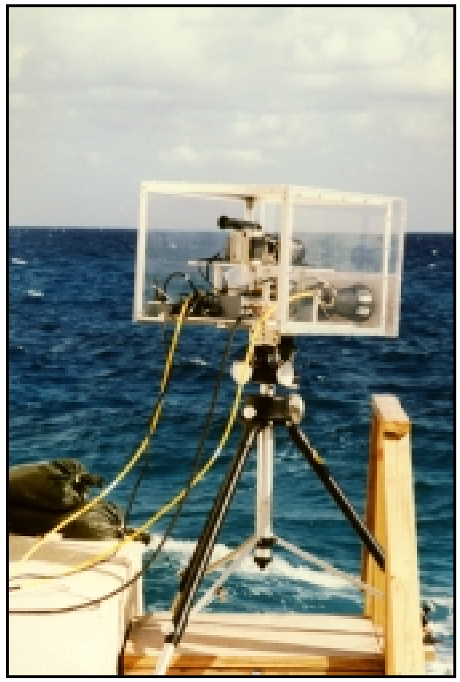
G. Linde • Code 5340.1 • (202) 767-2643

LOCATION:

Bldg. 75 • Chesapeake Bay Detachment, Chesapeake Beach, MD

Microwave Microscope (MWM)

Front view



Rear view

Transmit-receive head deployed on field site at AUTEC

FUNCTION: Makes ultrahigh-resolution field measurements. The Microwave Microscope (MWM) has been used in support of several NRL experimental programs involving sea scatter and mine detection.

EQUIPMENT: The MWM consists almost entirely of commercial-off-the-shelf (COTS) equipment. Antenna housings and polarization switching logic were designed and built at NRL.

DESCRIPTION: The MWM, an ultrawideband, ultra-high-resolution, dual-polarized measurement radar system, has been designed, implemented, and used in the field to measure ocean surface scattering at X-band frequencies. This experimental system uses a video-excited TWT to produce 2 kW peak power transmit pulses as short as 150 ps in duration. Instantaneous receive bandwidths greater than 8 GHz are supported by a unique direct sampling detector that uses off-the-shelf digital sampling oscilloscope components. Data output consists of coherent I and Q measurements in a fixed number of range cells at resample periods as short as 25 µs. Final system range resolution is better than 2 cm. The system has been used at a field site at AUTEC, in the Bahamas, to measure ocean surface scatter under high-wind, rough-sea conditions.

CONTACT:
K. Scheff • Code 5348 • (202) 404-1882
LOCATION:
Bldg. 60, Rm. 314 • NRL, Washington, DC

Advanced Technology Chamber (ATC)

Transmit/receive module assembly undergoing a radiated susceptibility assessment

FUNCTION: The NRL advanced technology chamber (ATC) is a welded aluminum shielded room (5.33 × 4.64 × 2.73 m). The ATC has two purposes: (1) as a mode stirred chamber to assess the electromagnetic (EM) susceptibility or emissions of electronic equipment and interfaces that might be installed on U.S. Navy ships or aircraft, and (2) as a research tool for investigating mode stirring phenomena.

INSTRUMENTATION: The ATC is support by the following instrumentation: (1) HP-8397 frequency synthesizer, (2) HP-8757D scalar network analyzer, (3) FM-1000 amplifier research electric field intensity meter, (4) Pentium 200 MHz Gateway PC, (5) assorted power amplifiers ranging in frequency from 100 MHz through 20.0 GHz, (6) computer-controlled stepper motor, (7) assorted antennas, and (8) microwave components.

DESCRIPTION: The ATC configured as a mode stirred chamber (MSC) excites a large number of different modes that characterize the distribution of the electric and magnetic fields from 200 MHz through 40 GHz. Mode stirring is accomplished by rotating a 1.0-m long aluminum stirrer that is situated just below the ceiling. The excitation of these large number of modes is the result of the changing boundary conditions on the rotating stirrer surfaces. The large number of modes provide a randomly polarized EM environment. The EM field within the chamber exhibits statistical uniformity for repeatability in measurements. Extremely large electric field intensity levels are achievable with modest amounts of input power due to the large Q factor (in excess of 50,000) that is presented by the aluminum cavity. Mode-stirred chambers have found wide acceptance for electromagnetic compatibility (EMC) susceptibility and emissions testing among the automotive and medical as well as the DoD communities. Recently, there has been a great deal of interest in electronic in place of mechanical stirring methods to expedite the measurement process. NRL is currently investigating a phase stirring approach where the excitation phases of three orthogonal wires are varied with respect to one another. An NRL patent (Application No. 82,622) has been applied for.

CONTACT:
L. Cohen • Code 5348 • (202) 404-7726
LOCATION:
Bldg. 69, Rm. 302 and 14 • NRL, Washington, DC

Information Technology Division

- Robot Laboratory
- Fleet Information Systems Security Technology Lab
- Navy Shipboard Communications System Testbed
- Virtual Reality Laboratory
- Ship Motion Simulator Facility
- Distributed Collaborative Engineering Environment Laboratory
- NEWAVE Research Center
- Motion Imagery Laboratory
- Distributed Center for High Performance Computing
- Scientific Visualization Laboratory

Robot Laboratory

Robot Laboratory

FUNCTION: Provides environment for developing and evaluating intelligent software for both actual and simulated autonomous vehicles. Laboratory computers provide environment for testing intelligent algorithms on simulated land, air, and sea vehicles. The laboratory, which includes several types of indoor and outdoor robot platforms, serves as a test bed for robotics applications. The mobile robots are also available as test platforms for sensors, interfaces, and other technologies being developed by groups within NRL.

INSTRUMENTATION: In addition to the robots' autonomous capabilities, communication with stationary host computers is available via two different 2.4 GHz wireless data networks and a 2.4 GHz wireless video system. Sensor data and robot performance are logged in software and are the responsibility of the principal investigator of any project.

DESCRIPTION: The robot laboratory is a 1256-ft^2 facility that allows freedom of motion for mobile robots and can be configured with obstacles or furniture to simulate a tested robot's expected working environment.

The facility maintains 10 commercial mobile robots from companies with a wide following in the robotics community. This enables the integration of outside research from other government, academic, and industry laboratories. The robots include seven Nomadic Technologies robots of varying design and capability for indoor applications and three RWI all-terrain robot vehicles for mixed indoor and outdoor applications.

Proprioceptive sensors on the robots include odometry, pitch/roll/yaw sensor, compass, inertial position tracker, and tactile bumpers. Onboard range finders include sonar, active infrared, scanning laser LIDAR, structured light, and stereo vision cameras. Computing facilities include many Sun workstations, Windows PCs, Linux PCs, and Macs in both desktop and notebook models.

CONTACT:

A. Schultz • Code 5515 • (202) 767-2684

LOCATION:

Bldg. 1, Rm. 105 • NRL, Washington, DC

Fleet Information Systems Security Technology Lab (FISSTL)

Fleet Information Systems Security Technology Lab (FISSTL)

FUNCTION: Provides unique facilities for NRL research into Navy information technology network security. From architectural design, review, and prototyping to component evaluation and integration, the FISSTL ensures secure capability and availability of Navy Network-centric information operations.

INSTRUMENTATION: Senior technical task leaders/principal investigators are responsible for test equipment and system components under development, including protocol analysis tools, vulnerability assessment tools, and network mapping instruments.

DESCRIPTION: The FISSTL has connectivity via the NRL LAN, NIPRNet, and the SIPRNet. Testbed configurations allow concurrent architectural design testing and evaluation of potential COTS/GOTS security components. Other aspects of the lab facilitate the development of Navy/DoD unique security components and systems.

CONTACT:
J. McLean • Code 5544 • (202) 767-3429
LOCATION:
Bldg. 12, Rm. 221-225 • NRL, Washington, DC

Navy Shipboard Communication System Testbed

Navy Shipboard Communication System Testbed

FUNCTION: Provides resources for initial development and testing of new secure voice technologies for Navy shipboard applications.

INSTRUMENTATION: The core of the laboratory is the shipboard secure voice installation. This equipment consists of a SAS 2112 Red Switch, the associated analog audio distribution system, which includes red phone stations and several racks of tactical radios.

The laboratory also contains a Lucent Definity PBX and several stations of digital telephones. Both the red analog and the digital telephony systems are linked to other Navy installations to provide outside connectivity for more extensive testing.

DESCRIPTION: This laboratory consists of a suite of rooms configured with Navy shipboard communications systems. By replicating the tactical communications installations aboard ships, this facility provides the means to perform interoperability testing of emerging communications technologies. It also contains workspaces for the development of both electronic hardware and the various levels of software (embedded to application level) that typically comprise communications devices.

CONTACT:
G. Kang • Code 5555 • (202) 767-2157
LOCATION:
Bldg. 1, Rm. 217 • NRL, Washington, DC

Virtual Reality (VR) Laboratory

The Virtual Reality Laboratory

FUNCTION: Performs basic and applied research in virtual reality (VR), augmented reality (AR), and interactive 3-D computer graphics. The VR Laboratory is also used to support the visualization of NRL scientific data sets

DESCRIPTION: The VR Laboratory includes an Immersive Room (the GROTTO), two VR Responsive Workbenches, head-mounted displays, a multipiped SGI Onyx Computer that drives the GROTTO display, two additional SGI Onyx computers, several lower-end SGI and PC workstations, wearable computers with see-through displays, magnetic and inertial trackers, and a variety of interactive devices.

The Immersive Room, sometimes known in the VR literature as a "CAVE," is a 10 × 10 × 8-ft room on which stereo images are projected onto four surfaces, allowing users to feel as though they are inside the virtual environment. By using a 3-D joystick and with the aid of magnetic trackers, a user navigates through the virtual scene (e.g., a ship, a battlefield, a scientific data set). The VR Responsive Workbench, an important VR display paradigm of which NRL was a pioneer, provides a semi-immersive stereo overview of a scene. The Workbench has been found to be an excellent tool for battlefield visualization. The suite of AR equipment is being used to develop new technologies for providing visual information to a mobile user that appears directly atop the real world.

CONTACT:
L. Rosenblum • Code 5580 • (202) 767-5333
LOCATION:
Bldg. 34 Annex • NRL, Washington, DC

Ship Motion Simulator Facility

Ship Motion Simulator Facility

FUNCTION: Provides a regional facility for conducting research under conditions of simulated shipboard motion. Research areas include the impact of shipboard motion upon engineering systems and sensors and the impact of shipboard motion upon human performance, particularly with respect to the interaction between human operators and sophisticated computer interfaces. This facility provides a cost-effective means for conducting such studies.

DESCRIPTION: NRL has owned and operated a ship motion simulator since 1943. Originally developed to provide gunnery practice for sailors, the ship motion simulator has been used more recently to test radar and satellite receiving systems. Under sponsorship of the Office of Naval Research, an operations van has recently been attached to the reinforced upper deck of the ship motion simulator. The van can accommodate five to six experimenters and subjects. A heating/cooling unit maintains uniform climate control. Shelves, desks, and work areas provide adequate space for computer monitors and support hardware. A permanent intercom system provides continuous communication between the occupants of the van and the ship motion simulator operators. Different motion scenarios can be designed and run as required. Hourly operating costs are low.

CONTACT:
R. Hillson • Code 5583 • (202) 404-7332

LOCATION:
Chesapeake Bay Detachment • NRL, Chesapeake Beach, MD

Distributed Collaborative Engineering Environment Laboratory

Distributed Collaborative Engineering Environment Laboratory

FUNCTION: Provides the Advanced Information Technology (AIT) Branch and NRL staff to conduct research in collaborative engineering environment with collaborative enterprise technologies.

DESCRIPTION: The laboratory includes many Pentium workstations, wireless Palm Pilots, and notebook computers running in a wireless network as well as other state-of-the art collaborative tools (e.g., smart white board). Also powered by a high-performance SUN, it supports desktop VTC, remote conferencing and distributed engineering. It provides a test bed for research in human/computer interaction and user interface for collaborative engineering environment. Advanced display systems such as augmented reality (AR) are used for user interface testing. Research in collaborative enterprise technology (which provides an efficient, distributed object computing framework for knowledge collection, distribution, and management) is being conducted.

CONTACT:
H. Ng • Code 5585 • (202) 767-6023
LOCATION:
Bldg. 34, Rm. 109B • NRL, Washington, DC

NEWAVE Research Center

Naval Engagement Warfare Analysis and Virtual Engineering (NEWAVE) Research Center

FUNCTION: Provides the Advanced Information Technology (AIT) Branch and NRL staff the capability to conduct research in virtual engineering, distributed simulation, parallel processing, and collaborative environment technologies.

DESCRIPTION: The NEWAVE facility has been developed as a multiscreen distributed simulation laboratory and viewport. It is powered by SGI workstations and servers, including a 8-CPU Onyx2 InfiniteReality2E with 16 GB Random Access Memory (RAM), 2 graphical pipelines, and hundreds of GB disk space as well as several Pentium Workstations linked to the NRL, HPC Distributed Center with ATM/SONET networking. The facility is capable of handling high-performance computing, graphics, and distributed simulation. It is a multipurpose facility, that can be used as a command center, battlefield visualization, virtual prototyping, flight simulator, collaborative engineering environment, warfare analysis, wargaming, and many other applications.

CONTACT:
H. Ng • Code 5585 • (202) 767-6023
LOCATION:
Bldg. 34, Rm. 124 • NRL, Washington, DC

Motion Imagery Laboratory (MIL)

Motion Imagery Laboratory

FUNCTION: Supports research in leading edge progressive scan imaging, high-definition television (HDTV), the technology needed to process very high-resolution images, and the impact on human perception with various presentation and image capture techniques.

DESCRIPTION: The MIL is a research environment that leverages high-end computational assets and networks in close association with applications that can take advantage of leading edge capabilities in state-of-the-art in motion imagery with progressive scan, HDTV. The MIL is working with imagery requirements in the near-term where 1.5 Gbps data streams are needed to handle the raw output and progressing to 10 Gbps and higher in the near future. The MIL at NRL includes projection facilities for very high definition immersion with surround screens, extremely high-resolution micromirror projection, progressive scan studio cameras, recording/replay capabilities, and other tools for comprehensive work in this area. The MIL is used to assess innovative techniques in next-generation video teleconferencing. Research efforts are conducted as to the collective issues of large single streams on gigabit networks over very long distances in real time and the visual tools to support next-generation motion imagery capabilities. The MIL provides an environment to assess collaboration in intelligence, digital earth model, test and evaluation, and other DoD needs where very high-resolution imagery would have an impact. The MIL supports work in compression technology, processing, transmission, and other technologies to allow access to high-resolution imagery across the spectrum of users from average users at their desktops to the most demanding scientific and analytic needs.

CONTACT:

H. Dardy • Code 5590.3 • (202) 404-7028

LOCATION:

Bldg. 97, Rm. 172 • NRL, Washington, DC

Distributed Center for High Performance Computing

Distributed Center for High Performance Computing

FUNCTION: As a Distributed Center (DC) in the DoD High Performance Computing Modernization Program (HPCMP), NRL's Center for Computational Science supports leading edge introduction of high performance computing to DoD. The Center makes available a range of shared resources, including massively parallel computer systems and high performance networks to NRL, Navy, and DoD scientific users.

DESCRIPTION: NRL's DC in the HPCMP supports the introduction of a variety of leading-edge technologies in high performance computing (HPC). The HPC work includes the introduction or extension of new architectures such as cache-coherent Non-Uniform Memory Access (cc-NUMA), Cache-only Memory Access (COMA), and Multi-Threaded Architectures (MTA) where the application requires access to global shared memory and large single images to achieve results. Research on the high-end computational assets and networks results in close association with applications that demand these leading edge capabilities. The Center not only operates and maintains leading edge super computers from Silicon Graphics (SGI) and others but supports the scientific users in porting their code to and using these high-end assets. User support includes both the computing assets at NRL as well as HPCMP assets at 20 other locations across DoD. The Center also has more than 12.5 TB of on-line shared rotating disk and robotic storage systems for fileserving and archiving that currently holds 350 TB of multimedia data and is scalable to over a petabyte (Pbyte). HPC research extends to the high performance networks needed for true distributed computing, including the Defense Research and Engineering Network (DREN) and the Advanced Technology Demonstration network (ATDnet). The networking efforts include transparent and ubiquitous computing, security and work in dense wave division multiplexing (DWDM), and switching in optical networks.

CONTACT:

J. Osburn • Code 5594 • (202) 767-3885

LOCATION:

Bldg. A49, Rm. 15 (Computer Room - Rm 108) • NRL, Washington, DC

Scientific Visualization Laboratory (Viz Lab)

Scientific Visualization Laboratory

FUNCTION: The Scientific Visualization Laboratory (Viz Lab) is an information center, a video production unit, and a training center for the latest tools in scientific visualization and visual supercomputing. The Viz Lab provides general support across NRL to assist scientists and engineers in producing visual rendering of their work.

DESCRIPTION: The Viz Lab assists scientists at NRL across a broad range of disciplines in taking computational results of their work and applying a visual dimension for further insight and understanding. NRL researchers have direct or networked access to computational and high-end graphics workstations. The Viz Lab has a comprehensive digital broadcast-video editing suite. Alone or assisted, a researcher can quickly produce a professional quality video, including titles and special effects from a montage of computer generated video, stills, graphs, overheads, or even raw data. A wide range of output formats are supported, including color prints, 35-mm slides, computer animations, videotape, or high-resolution digital video display (DVD). The Viz Lab staff also assists researchers in porting their scientific applications to the Virtual Reality Lab's GROTTO for 3-D, interactive, stereo viewing.

CONTACT:
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LOCATION:
Bldg. A49, Rm. 4 • NRL, Washington, DC

Optical Sciences Division

- Fiber Fabrication Facility for Non-Oxide and Specialty Glasses
- Nanochannel Glass Technology Facility
- Infrared Range Facility
- IRCM Techniques Laboratory
- Missile Warning System Facility
- Focal Plane Array Evaluation Facility
- Fiber Optic Optical-Microwave Laboratory
- Fiber-Optic Sensor Facility
- Oxide Optical Fiber Fabrication Facility

Fiber Fabrication Facility for Non-Oxide and Specialty Glasses

Fiber Fabrication Facility for Non-Oxide and Specialty Glasses

FUNCTION: Unique facility for the research, development, and fabrication of non-oxide and specialty glasses and fibers in support of Navy/DoD programs.

INSTRUMENTATION: Equipment is available for characterization of glass physical, thermal, and optical properties. Infrared (IR) lasers and spectrometers are routinely used for fiber characterization.

DESCRIPTION: Three Class 100 clean rooms, covering approximately 1500 ft^2, contain several fume hoods and inert gas dry-boxes for chemical handling. Resistance furnaces and RF induction furnaces are used for chemical purification and glass melting. Two state-of-the-art draw towers are used for fabricating fiber from specialty glasses under controlled atmospheres using distinctly different techniques, namely, preform and double crucible processes, respectively. The fibers fabricated at this facility possess low loss, high strength, and high threshold to laser damage and are enabling many Navy/DoD applications.

CONTACT:
J. Sanghera • Code 5606 • (202) 767-5836
LOCATION:
Bldg. 215, Rms. 243 and 244 • NRL, Washington, DC

Nanochannel Glass Technology Facility

Nanochannel glass draw towers housed in a Class 100 clean room

FUNCTION: Provides for the fabrication of nanochannel glass, a specialized composite glass material that has regularly spaced features on a nanometer-size scale. Nanochannel glasses are used in the fabrication of nanocomposite and nanopatterned materials.

INSTRUMENTATION: The Nanochannel Glass Technology Facility is fully equipped to address all aspects of fabrication, processing, and characterization of nanochannel glass. Specific instrumentation available at the facility includes:

- two18-ft draw towers contained in a Class 100 clean room
- computer control of down feed, furnace temperature, and pinch wheels
- optical microscopes
- atomic force microscope
- thermal analysis instrumentation (TGA, DTA and DSC) wafering, grinding, and polishing equipment.

DESCRIPTION: The Nanochannel Glass Technology Facility includes a state-of-the-art, fully automated, glass fiber draw tower. This draw tower is specially equipped to permit the drawing of multielement fiber bundles. Nanochannel glasses are fabricated by first stacking thousands of composite glass fibers together in hexagonal-shaped bundles. These multielement bundles are drawn, using the draw tower, into boules that contain parallel arrays of fused nanometer-scale fibers or channels. The nanochannel glass boules are processed by slicing the boules into wafers that are subsequently etched, ground, polished, and characterized.

CONTACT:
B. Justus • Code 5611 • (202) 767-9468
LOCATION:
Bldg. 216, Rms. 1030C-E • NRL, Washington, DC

Infrared Range Facility

Infrared Range Facility

FUNCTION: Enables scientists to measure the infrared (IR) signature of scale aircraft or ship models in a controlled environment, to test the effectiveness of new low observable coatings, and/or to validate IR signature codes against range imagery. Simulates the IR environment from sea level to 30-kft altitudes, provides viewing angles representative of standard IR threats, provides versatile control of scale model temperatures and orientations, and provides a low-cost alternative to IR field testing.

INSTRUMENTATION: State-of-the-art focal plane array cameras, low-temperature blackbodies, hemispherical directional reflectometers, and laser-based scatterometers for measuring the bidirectional distribution function.

DESCRIPTION: The NRL Infrared Range is a unique national user facility that serves the low-observable community. The range is a 14-ft diameter, temperature-controlled, cylindrical enclosure that is treated with high emittance coatings on the inner walls. The enclosure is surrounded by a 20-ft diameter thermal chamber. Test articles are inserted through the roof of the chamber and can be viewed over a range of elevation angles from –20 to +45°. The test article itself can be rotated through ±180°, tilted through ±45°, and temperature controlled through a variety of heaters and/or temperature conditioned fluids. A midwave infrared (MWIR) source is available for semiquantitative solar simulations. The dry air atmosphere within the chamber has a dewpoint of approximately –70°C and a CO_2 level of below 1 PPM. Low CO_2 levels are needed to minimize absorption in the CO_2 absorption doublet near 4.2 µm. The low dewpoints are needed to minimize frost formation on the chamber walls when configured for high-altitude conditions (e.g., 30-kft long wavelength infrared (LWIR)). The chamber walls used to simulate the zenith sky can attain temperatures as low as –110°C. The sky panels are coated with a new type of flocked black coating with a hemispherical reflectance below 0.2% throughout the IR. Without such a coating, the thermal radiation from the warm Earth panels would reflect from the sky panels and overwhelm the emitted radiation from the sky.

CONTACT:
K. Snail • Code 5620 • (202) 404-7308
LOCATION:
Bldg. 216, Rm. 1032D • NRL, Washington, DC

IRCM Techniques Laboratory

Open loop rate table for hardware IRCM testing

FUNCTION: Assists the Navy and Marine Core in the development of infrared countermeasure technology and techniques for Fleet aircraft protection. Specifically, requirements for IRCM techniques to defeat infrared threats, imaging and reticle base surface-to-air (SAM) and air-to-air (AAM) IR missiles and forward-looking infrared (FLIR's) devices, are determined. IRCM technologies and techniques include sensor damage, coherent and incoherent jamming, and expendable/flares.

INSTRUMENTATION:
- two open-loop rate tables for IRCM testing of reticle and imaging IR seekers
- 64-channel analog data acquisition system
- three multiprocessor simulation workstations – SPARC, ALPHA, and MIPS machines
- one SGI 8-processor simulation supercomputer.

DESCRIPTION: The InfraRed Countermeasure (IRCM) Techniques Laboratory performs open-loop hardware testing of "real" missile/sensor threat seekers as well as all digital missile modeling and simulation analysis to determine countermeasure requirements to defeat the IR threat. The laboratory provides a comprehensive test bed for all types of IR countermeasures against a variety of IR threats. The facility includes advanced countermeasure sources for the testing of directed IRCM (DIRCM/ATIRCM) style countermeasure systems and a two-color multiflare/expendable hardware simulator for testing advanced expendable techniques against multispectral threats. The laboratory also has an extensive modeling and simulation capability for testing of IRCM against both reticle-based and IR focal plane array-based missile seekers.

CONTACT:
F. Barone • Code 5631 • (202) 767-2115
LOCATION:
Bldg. A50, Rm. 187 • NRL, Washington, DC

Missile Warning System Facility

Missile Warning System Facility

FUNCTION: Operates a classified facility for research projects dedicated to the development of missile warning systems for the self-protection of Naval aircraft. Participates in exploitation measurements of missile signatures. Simulates the acquisition, guidance, and aerodynamic performance of threat missiles. Measures and models sensor responses to threat signatures as well as the performance of detection and declaration algorithms.

INSTRUMENTATION: Principal instrumentation consists of a classified network of computer workstations capable of hosting both system data and the required system software simulations.

DESCRIPTION: An extensive database of threat and background clutter signatures is maintained for developmental and fielded self-protection systems. Participation in field tests (missile live firings and overflights) ensures the data's relevance to the developmental effort. Simulations of threat missile engagements along with simulations of system hardware permit predictions of system performance. Recent activities include support for the AN/AAR-47 Missile Warning Set and the NRL Tactical Aircraft Directed IR Countermeasures system.

CONTACT:
H. Romero • Code 5633 • (202) 767-9530
LOCATION:
Bldg. 216, Rm. 1024 • NRL, Washington, DC

Focal Plane Array Evaluation Facility

Focal Plane Array Evaluation Facility

FUNCTION: Determines the development status, provides guidelines for future development contracts, and evaluates the potential of prototype focal plane arrays (FPA) to fulfill Navy sensor requirements, both optical and electrical.

INSTRUMENTATION: The facility has extensive automated capabilities to measure the optical and electrical characteristics of focal plane arrays being developed for advanced Navy sensors. The facility includes clocking and drive electronics to operate the multiplexers on the array, calibrated continuous and pulsed infrared sources, electronics for video signal processing and digitization, and computer data reduction and display. It also includes image processing equipment to analyze algorithms for correcting nonuniformities in array response, to control signal processing within the focal plane, to provide real-time visualization of imagery from multispectral arrays, and to generate enhanced spatial resolution video from image sequences.

DESCRIPTION: The automated FPA evaluation facility consists of optical sources, signal generation and processing electronics, and data acquisition and analysis processors that are required to evaluate visible and infrared (IR)multispectral FPAs composed of optical sensing elements and signal multiplexing electronics in a single microchip. Since developmental arrays are often received in chip format, a variety of dewars and mounts are available to accept different chip carriers. Optical sources are used to illuminate the detectors with short pulses or continuous radiation in both uniform and single detector modes. Calibrated laser sources are used to study array performance under optical overload conditions. The data are acquired, processed, displayed, and stored using computer techniques because each array may consist of hundreds of millions of detectors, and many samples are required for statistical significance. Optical filters and spectrometers are used to provide photons within multiple spectral bands.

CONTACT:
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LOCATION:
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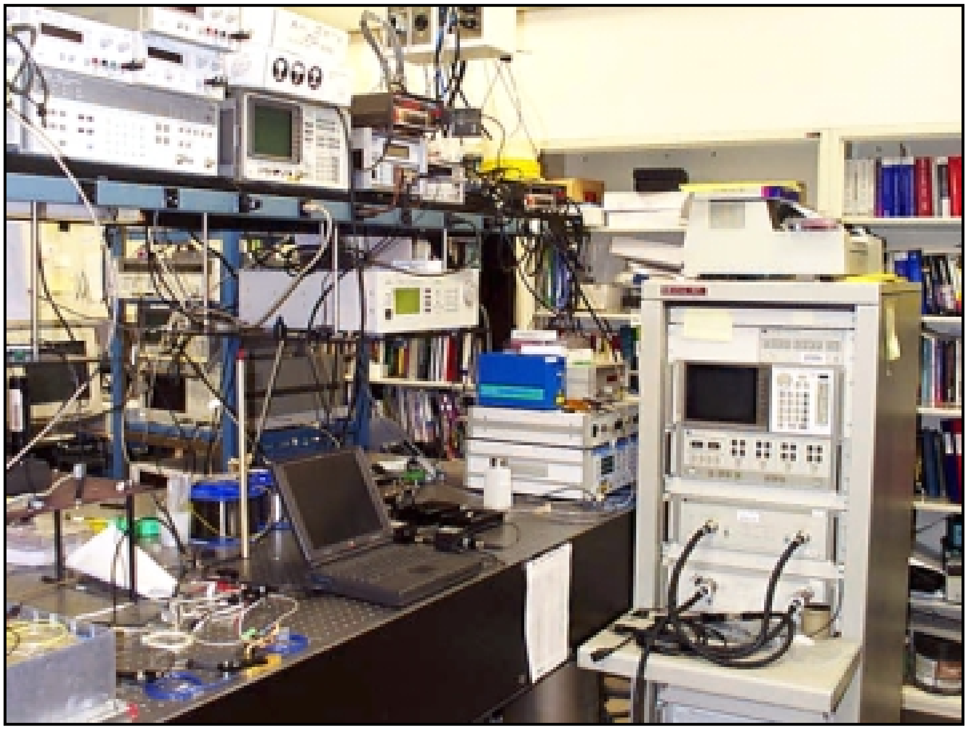
Fiber Optic Optical-Microwave Laboratory



Fiber Optic Optical-Microwave Laboratory

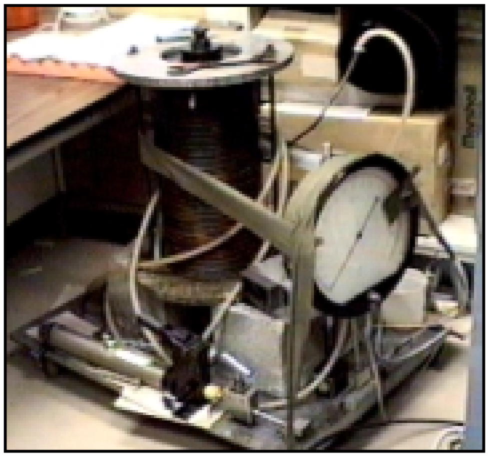
FUNCTION: Used to conduct programs of basic science and applied research in the development of laser sources, high-power fiber amplifiers, photonic control of phased arrays, antenna remoting, and microwave frequency conversion.

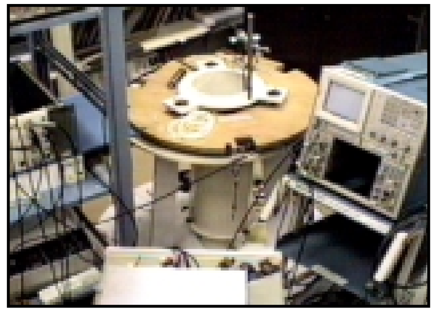
INSTRUMENTATION: The laboratory equipment includes an extensive array of microwave and optical test equipment. Optical and microwave components used in the lab are primarily commercially available and represent the state-of-the-art in microwave photonics technology.

DESCRIPTION: The laboratory is equipped with state-of-the-art microwave and mm-wave components along with a wide variety of fiber and free space optics. Microwave photonics derives its strength from the merger of microwave and fiber-optic techniques for the development of systems with greater than 100 GHz of operational bandwidth. This merger has enabled the development of photonic links for low-loss antenna remoting, true-time delay for squint-free beam steering, microwave frequency conversion, low-noise optical transmitters, and highly efficient photodetectors. In addition, the optical and microwave components used in these systems are commercially available and are improving with advances in the telecommunications industry. Research equipment includes a wide variety of microwave and optical test instruments and components enabling the development of optical techniques valuable for future Navy capability.

CONTACT:
K. Williams • Code 5650 • (202) 767-9360
LOCATION:
Bldg. 215, Rm. 122 • NRL, Washington, DC

Fiber-Optic Sensor Facility





Fiber-Optic Sensor Facility

FUNCTION: Constructs and evaluates fiber-optic sensors for a variety of measurands. These measurands include acoustic, pressure, magnetic, and electric field as well as strain and rate of rotation.

INSTRUMENTATION: Seven Hewlett Packard 3562A and three Hewlett Packard 3582A dual-channel spectrum analyzers, one Hewlett Packard 3567 modular three-channel spectrum analyzer, three Tektronix single-channel spectrum analyzers, two HP 89410 network analyzers, three TEAC RD-200T 16-channel digital audiotape recorders, and one RX-800 32-channel DAT recorder. Other instrumentation include an Anritsu MS 9710B Optical Spectrum Analyzer and an HP 8509B Lightwave Polarization Analyzer.

DESCRIPTION: The sensor construction facility includes two Accuwinder coil winding machines, seven optical fiber fusion splicers, annealing facilities for magnetic materials, and facilities for degassing adhesives for potting purposes. The evaluation facilities include two computer-controlled data reduction and analysis stations, one optimized for acoustic sensors and the other optimized for magnetic sensors. There are two environmental chambers that operate from –50° to 100° C for life testing of prototype sensors. The acoustic sensor evaluation facility also includes a pressure chamber for determining dc acoustic sensitivity as well as crush performance of prototype fiber-optic hydrophone designs (see left figure). Also available is a G-40 shipboard calibrator, which can operate over a 5 to 1000 Hz frequency range at ambient pressure and between 4° and 35° C (see right figure). The evaluation facility for rate of rotation sensors includes a Contraves rate table (1,000°/s to Earth rate) and a suite of measurement equipment. The evaluation facility for magnetic sensors includes mumetal magnetic shields for low noise measurements and an automated system for dynamic magnetization and Barkhausen noise measurements. The facility has optical test equipment to evaluate optical sources as well as an OTDR and a SMARTS system to evaluate fiber-optic circuitry. A number of optical sources at 1.3 and 1.5 µm wavelengths (including a tunable source) are also available.

CONTACT:
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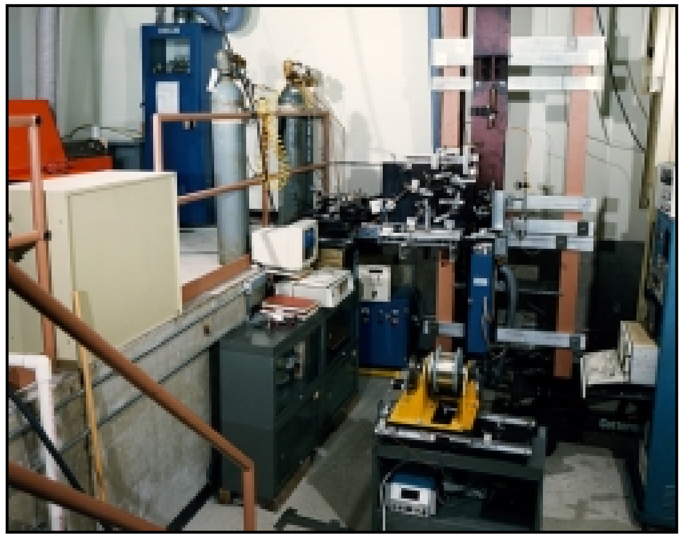
LOCATION:
Bldg. 216, Rm. 1006 • NRL, Washington, DC

Oxide Optical Fiber Fabrication Facility



Fiber draw tower showing excimer laser and UV interferometer for fabrication of fiber Bragg grating arrays in line during fiber drawing

FUNCTION: Fabricates unique state-of-the-art optical fibers based on the doped silica glass system. It has the capability of fabricating both single-mode and multimode fibers doped with germanium, phosphorus, and fluorine. In addition, it can fabricate fibers with cores doped with high concentrations of laser-active ions such as erbium, ytterbium, and neodymium, together with aluminum. The facility supports Navy and DoD programs in fiber-optic sensing, nuclear radiation hardness, high-power fiber lasers, and small fibers with low visibility.

INSTRUMENTATION: In the preform fabrication laboratory, where the gas and rare Earth chelate delivery systems are computer-controlled, there is closed-loop control of the preform temperature using pyrometers and of preform diameter using an optical diameter monitor and gas back pressure regulator. During drawing, the fiber diameter, coating diameter, and concentricity are monitored with laser-based optical instruments. A non-contact instrument measures draw tension. The wavelength and spacing of the fiber Bragg gratings are computer-controlled, and the gratings are written with a KrF excimer laser.

DESCRIPTION: The facility consists of two parts: the preform fabrication laboratory and the draw lab. In the first, optical fiber preforms are fabricated using the modified chemical vapor deposition process. The optical cladding and core are deposited layer by layer, and then the preform is collapsed into a solid rod whose refractive index profile and core/clad ratio are preserved in fiber drawing. In the Fiber Draw Laboratory, the preform is slowly lowered into a high-temperature furnace at the top of the 24-ft draw tower. The glass softens and the optical fiber is drawn out of the bottom of the furnace, and the fiber diameter and draw tension are monitored using noncontact techniques. Fiber Bragg gratings may be written into the fiber with short pulses of ultraviolet light from an excimer laser. The fiber is coated with a polymer to protect its surface and preserve its intrinsic strength.

CONTACT:
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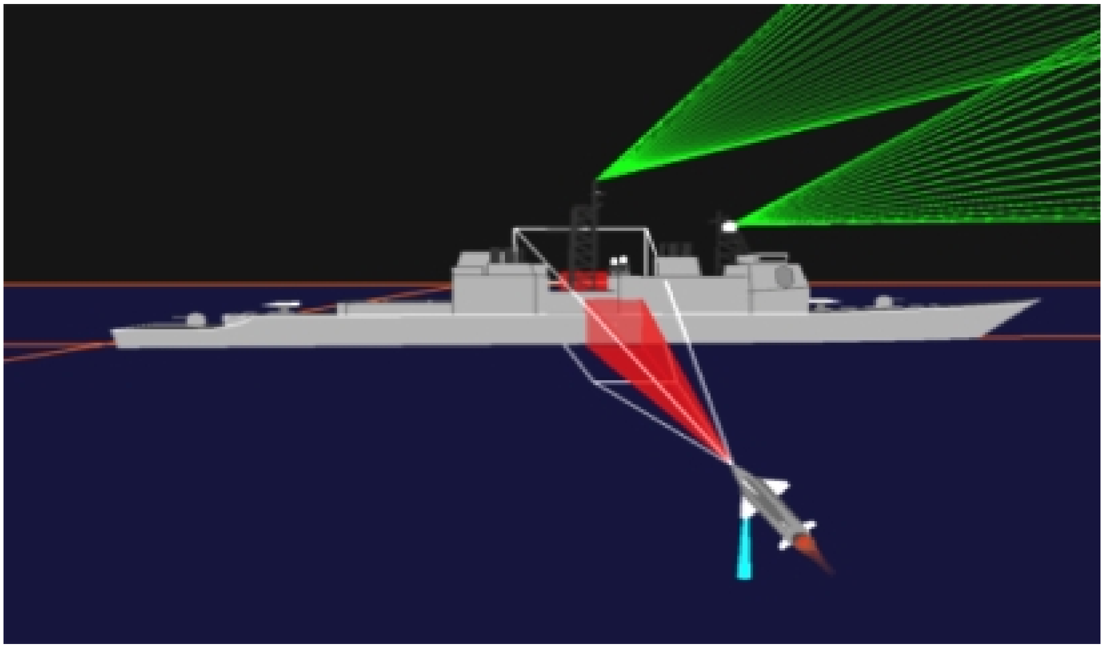
LOCATION:
Bldg. 216, Rms. 1034 and 1035 • NRL, Washington, DC

Tactical Electronic Warfare Division

- Visualization Laboratory
- Off-Board Test Platform
- Transportable Radar Cross Section Measurement Radar
- Vehicle Development Laboratory
- Advanced Tactical Electronic Warfare Environment Simulator
- Mobile ESM Laboratory
- Compact Antenna Range Facility
- Isolation Measurement Chamber Facility
- Millimeter Wave Anechoic Chamber Facility
- Low-Power Anechoic Chamber
- Search Radar ECM/EA Simulator
- Electro-Optics Mobile Laboratory
- Infrared/Electro-Optical Calibration and Characterization Laboratory
- Infrared Missile Simulator and Development Laboratory
- Scale Model Analysis Facility
- Secure Supercomputing Facility
- Central Target Simulator Facility
- Flying Electronic Warfare Laboratory

Visualization Laboratory



Visualization Laboratory

FUNCTION: Evaluates and improves the operational effectiveness of existing and emerging electronic warfare systems. By analyzing and visualizing the results of scenarios, the requirements in design, tactics, and training are assessed.

INSTRUMENTATION: The Visualization Laboratory is equipped with advanced computer graphics workstations, large display monitors, software tools, and video production equipment. Approximately 40 Silicon Graphics workstations are used for software development and to interactively design and visualize simulations. A fiber-optic network is in place to display results in conference rooms and auditoriums.

DESCRIPTION: The Visualization Laboratory evaluates and improves the operational effectiveness of existing and emerging electronic warfare systems. By analyzing and visualizing the results of scenarios, the design, tactics, and training are assessed. Three-dimensional computer graphics are used to display parameters in an intuitive manner, providing depth, volume, and spatial information. Several analysis routines exist to review the static and dynamic components of the simulation. Static analysis tools convey attributes such as number of platforms, missiles, and emitters used within the simulation, the location of emitters on various platforms, and their characteristics. Dynamic analysis tools convey information about time variant components, the number of emitters detectable, their bearing, and operation mode. Digital terrain elevation data are used to provide accurate representation of geographical areas. Multimedia interfaces to naval platform and Geographical Information System data-bases also exist.

CONTACT:
A.A. Di Mattesa • Code 5701 • (202) 767-5974
LOCATION:
Bldg. 210, Rm. 3434 • NRL, Washington, DC

Off-Board Test Platform

Off-Board Test Platform

FUNCTION: Measures the aerodynamic forces and moments and studies the airflow characteristics over off-board countermeasures deployment vehicles. Supports the development and testing of propulsion systems for deployment vehicles. This facility is especially suited to the study of subsonic low Reynolds number aerodynamics because of its low turbulence intensity.

INSTRUMENTATION: The aerodynamic test section has a full 3-axis, 6-component strain gauge balance; a 48-port scanivalve pressure measurement system; and an automated data collection system.

DESCRIPTION: This facility is particularly focused on the development of air vehicles designed to operate at low speed, low altitude, and low Reynolds number. The wind tunnel is a continuous flow design that operates over a range of 20 to 200 kts and has two interchangeable test sections. The aerodynamic test section has a 4×4-ft cross section and a full 3-axis, 6-component strain gauge balance. Models are attached to the balance "sting," which can be manually or automatically controlled to sweep through ranges of angle of attack and sideslip, while force and moment data are collected. The propulsion test section is used to develop electric, internal combustion, and miniature turbojet engines. It features an open-jet test section and provides a simulation of in-flight airflow conditions.

CONTACT:
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LOCATION:
Bldg. 210, Rm. 2305 • NRL, Washington, DC

Transportable Radar Cross Section Measurement Radar (TSFR)

Transportabke Radar Cross Section Measurement Radar

FUNCTION: Provides a mobile facility to characterize and quantify the radar cross section (RCS) signature of ships and electronic warfare (EW) passive and active systems over 8 to 18 GHz and at 35 GHz. Additionally, the system can measure the Effective Radiated Power (ERP) and sensitivity of active EW systems over the same frequency range.

INSTRUMENTATION: The data radar is calibrated by using a combination of internal and external procedures. Effective radiated power (ERP), sensitivity, and RCS data are collected on a pulse-by-pulse basis using fast analog-to-digital converters (ADCs) and data collection and storage systems. The target of interest from each radar pulse is digitized and stored for post-test data processing. Data processing is very flexible, with the form of the processed data tailored to user requirements.

DESCRIPTION: The facility consists of I-band tracking radar, an optical designator to aid in target acquisition, a broadband 1-kW traveling wave tube (TWT) based radar for ERP, RCS, and sensitivity measurements, and a 60-kW, 35 GHz radar. Radar parameters such as pulse repetition frequency, pulse width, frequency, transmit polarization, and receive polarization are programmable. RCS measurements can be made at selectable transmit polarizations with received polarization switchable on a pulse-by-pulse basis if required. All three radars are housed in an 8 × 24-ft instrumentation hut with all antennas and a 60-kW diesel generator mounted on a 45-ft trailer that can be moved to any test range where measurements are to be made.

CONTACT:
F. Klemm • Code 5710 • (202) 767-2615
LOCATION:
Bldg. 210 • NRL, Washington, DC

Vehicle Development Laboratory

The High Resolution Airglow and Aurora Spectroscopy (HIRAAS) experiment during ground testing

FUNCTION: Supports the development of prototype deployment platform vehicles for off-board countermeasures systems.

INSTRUMENTATION: The Vehicle Development Laboratory has supporting equipment and instrumentation associated with prototype flight testing such as radio control systems, miniature autopilot, video cameras, data collection systems for both onboard and radio frequency (RF) telemetry, and a variety of sensors such as accelerometers, gyros, airspeed, and altitude transducers.

DESCRIPTION: The Vehicle Development Laboratory is involved in areas of technology development related to off-board countermeasure deployment platforms. These activities include research in new airframe materials and fabrication techniques, low-cost flight control sensors and controllers, and low Reynolds number airfoil design. Full-scale and subscale remote control and autonomous prototype vehicles are fabricated and flight tested. Also, avionics subsystems and deployment mechanisms are refined through flight testing aboard various remotely piloted test aircraft operated by the laboratory.

The Vehicle Development Laboratory has a substantial capability to fabricate airframe and mechanism test articles, light metal working, and composite structures.

CONTACT:
F. Klemm • Code 5710 • (202) 767-2615
LOCATION:
Bldg. 210, Rm. 2494 • NRL, Washington, DC

Advanced Tactical Electronic Warfare Environment Simulator (ATEWES)

Advanced Tactical Electronic Warfare Environment Simulator

FUNCTION: Provides real-time, hardware-in-the-loop test and evaluation of electronic warfare (EW) sensor systems and concepts in the 0.5 to 18.0 GHz microwave range.

INSTRUMENTATION: ATEWES uses a complete complement of laboratory microwave instrumentation: network analyzers, spectrum analyzers, microwave frequency counters, power meters, microwave synthesizers, digital-controlled oscillators, function generators, and solid-state amplifiers. Internal data recording includes a record of simulation data and signal-level pulse history of all pulses delivered to the system that is under test. Computer displays include interactive graphics operator terminal and 3-D color graphics situation display.

DESCRIPTION: ATEWES is a general-purpose system designed to provide complex and realistic radio frequency (RF) signal environments for laboratory testing and evaluation of modem EW/ESM (electronic warfare/electronic support measures) systems. The most significant aspect of the ATEWES is its ability to generate a near real-world dynamic RF environment consisting of up to 1,000 simultaneous signals with a combined pulse density of 1,000,000 pps. Frequency coverage of 0.5 to 0.18 GHz and hemispheric spatial coverage with azimuth and elevation accuracies of approximately 1.0 mrad are provided. This overall capability is driven by an operator-defined scenario that can be rapidly programmed for operational use. This level of performance permits laboratory evaluation of modern EW/ESM systems under controlled conditions and can minimize or avoid costly at-sea or flight testing, while allowing new system development and concepts to transition to the Fleet with reduced time and cost. Recent ATEWES enhancements include complex features for evaluating real-time battle force engagements in 3-D space. ATEWES can be configured to interface with the system-under-test through a variety of means that include direct-coupling, free-space radiated in interface with (and combined utilization of) the Central Target Simulation anechoic chamber.

CONTACT:
R. Oxley • Code 5720 • (202) 767-3139
LOCATION:
Bldg. 210, Rm. 3304 • NRL, Washington, DC

Mobile ESM Laboratory

Mobile ESM Laboratory

FUNCTION: Accommodates a wide range of electronic systems testing operations in a variety of environments. It has the ability to install large amounts of electronic equipment and provide facilities for operations, maintenance, and engineering support for field testing and research.

INSTRUMENTATION: Test equipment is provided for the mobile laboratory depending on the experiments to be run (i.e., receivers, oscilloscopes, antennas, and signal processors).

DESCRIPTION: The Mobile ESM Laboratory is a fully self-contained mobile laboratory. The basic structure is a heavy duty diesel truck containing a standard 22-ft aluminum van body. The truck mechanical systems include a lift tailgate, leveling and stabilizing systems, and a roof hoist. Self-contained power generation capabilities include a diesel powered, 12 kW, 60 Hz generator with power regulator and a 2 kVA, 400 Hz, 3-phase converter. Two permanently mounted pneumatic mast systems with controllers permit elevation of 200-lb loads to heights more than 40 ft above the van roof level. Auxiliary support systems include video cameras, marine radars, communication systems, and a global positioning satellite (GPS) receiver. The internal work space includes multiple 19-in. racks for mounting electronic systems, various work tables, and storage cabinets. The van is provided with a full complement of environmental control systems.

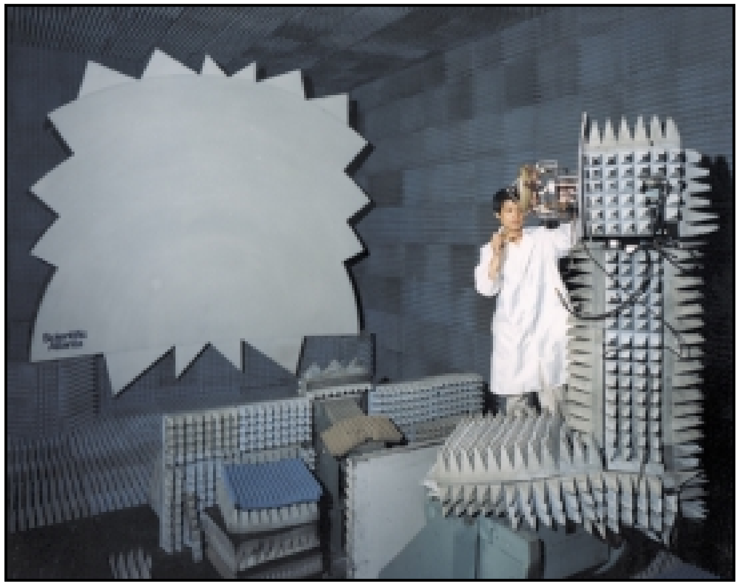
CONTACT:

R. Oxley • Code 5720 • (202) 767-3139

LOCATION:

Bldg. 210 (Rear) • NRL, Washington, DC

Compact Antenna Range Facility



Compact Antenna Range Facility

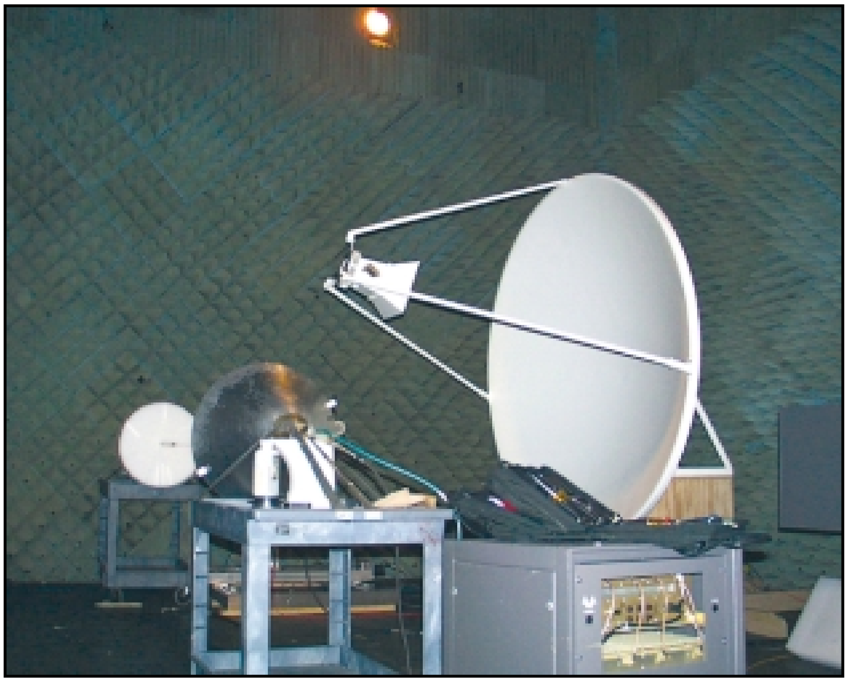
FUNCTION: Supports the measurement of phase and amplitude pattern characteristics of antenna systems over a frequency range of 2.0 to 90.0 GHz in a controlled environment. The facility also provides the capability for radar cross section (RCS) measurements from 2.0 to 40.0 GHz and small device characterizations from 450 MHz to 50.0 GHz.

INSTRUMENTATION: The Compact Antenna Range Facility uses a complete complement of microwave laboratory instrumentation, including network analyzers, microwave receivers, spectrum analyzers, microwave frequency counters, power meters, function generators, and microwave synthesizers. Data recording instrumentation includes an analog strip-chart recorder, an X-Y plotter, and a digital recorder. RCS measurements are made by using a Hewlett-Packard 8530 microwave receiver. Currently, four simultaneous channel measurements can be made to characterize an antenna or the RCS of a target in the 2.0 to 26.0 GHz frequency range. A Hewlett-Packard 8510C automatic network analyzer is available for small device characterization.

DESCRIPTION: The facility is an anechoic chamber that is designed to operate in conjunction with a Scientific Atlanta Compact Range Model 5751 with millimeter wave (MMW) reflector. The compact antenna range facility consists of a shielded anechoic chamber (18 ft high × 22 ft wide × 40 ft long) and a geometry that enables farfield radiation patterns to be taken in a small space. Illumination of the MMW reflector at one end of the chamber provides a cylindrical quiet zone (4 ft in diameter × 6 ft long) in which all the radiation patterns are measured. The quiet zone is specified to provide ≥ 45 dB of background noise isolation from 2.0 to 8.0 GHz and ≥ 50 dB from 8.0 to 94.0 GHz. The amplitude taper is specified to be ≤ 0.5 dB over the quiet zone, with a corresponding specification of ≤ 10° phase taper. Test antennas or subsystems are positioned by attaching them to an azimuth-over-elevation mount. Further degrees of freedom (DOF) are allowed with the mounting point being on a roll axis and the entire positioner on a slide axis. A second roll axis is provided for source illumination and enables the source polarization to be quickly rotated.

CONTACT:
G. Cowart • Code 5730 • (202) 404-7650
LOCATION:
Bldg. 210, Rm. 1141 • NRL, Washington, DC

Isolation Measurement Chamber Facility



12-ft antenna dish in the Isolation Measurement Chamber

FUNCTION: Provides the capability for measuring antenna-to-antenna radiation coupling characteristics from 2.0 to 40.0 GHz. The configuration, size, and special handling equipment of the facility allow for accommodation of large antennas and devices that are under test. The facility also supports making accurate measurements of the radar cros section (RCS) of small cross-section objects.

INSTRUMENTATION: This facility has no dedicated instrumentation; users supply their own measurement equipment. Typically a Hewlett-Packard 8510C automatic network analyzer is configured to make RCS measurements of targets in the chamber. A number of different size RCS calibration spheres and antennas up to 40.0 GHz are available.

DESCRIPTION: The facility is a shielded anechoic chamber that is 24 ft wide × 30 ft long × 50 ft high. The quiet zone is located at the base of the chamber and has an extent of 12 ft wide × 18 ft long × 10 ft high. Quiet zone reflectivity measurements (i.e., dB below incident power) are >75 dB at 2.0 GHz, >85 dB at 4.0 GHz, >95 dB at 6.0 to 8.0 GHz, and >100 dB at 18.0 GHz. The chamber walls facing the control room are designed to be removed to allow installation of large targets.

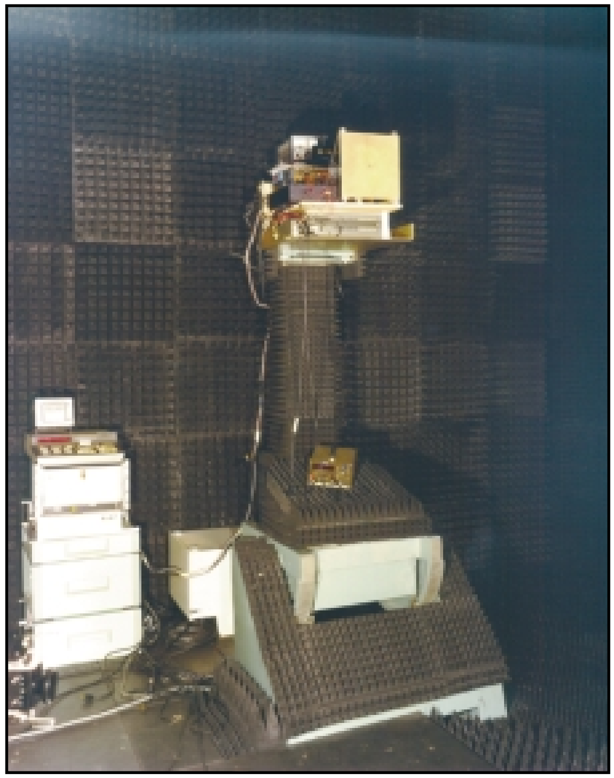
CONTACT:

G. Cowart • Code 5730 • (202) 404-7650

LOCATION:

Bldg. 210, Rm. 1147 • NRL, Washington, DC

Millimeter Wave Anechoic Chamber Facility



MMW transmitter and aperture mounted in the Millimeter Wave Anechoic Chamber Facility

FUNCTION: Measures antenna radiation patterns and other low-power millimeter wave (MMW) measurements over a frequency range of 8.0 to 100.0 GHz. The facility also provides the means to measure the radio frequency (RF) characteristics of radomes intended for use in homing missiles or other target tracking radar systems.

INSTRUMENTATION: The MMW anechoic chamber facility was designed to operate with a Scientific Atlanta Model 5751 Compact Range instrumentation. One Scientific Atlanta antenna mount has a 125-lb weight limit and is centered in the quiet zone. This mount has roll, azimuth, and elevation control. The mount at the other end of the chamber has only roll angle adjustment. Control of the mount orientations is done remotely. Scientific Atlanta RF synthesizers up to 40.0 GHz are available. Also available are a full range of pyramidal standard gain horn antennas and mixers operating up to 100.0 GHz. The facility can operate with a Hewlett-Packard 8510C automatic network analyzer that has a capability up to 50.0 GHz.

DESCRIPTION: The facility is a shielded anechoic chamber that is 16.5 ft wide × 28.5 ft long × 16 ft high lined with radar absorber. The quiet zone is a 3-ft diameter sphere located at one end of the chamber. Quiet zone reflectivity measurements, i.e., dB below incident power, are >40 dB between 8.0 to 18 GHz, and >50 dB between 18.0 to 100.0 GHz. At each end of the chamber are antenna mounts.

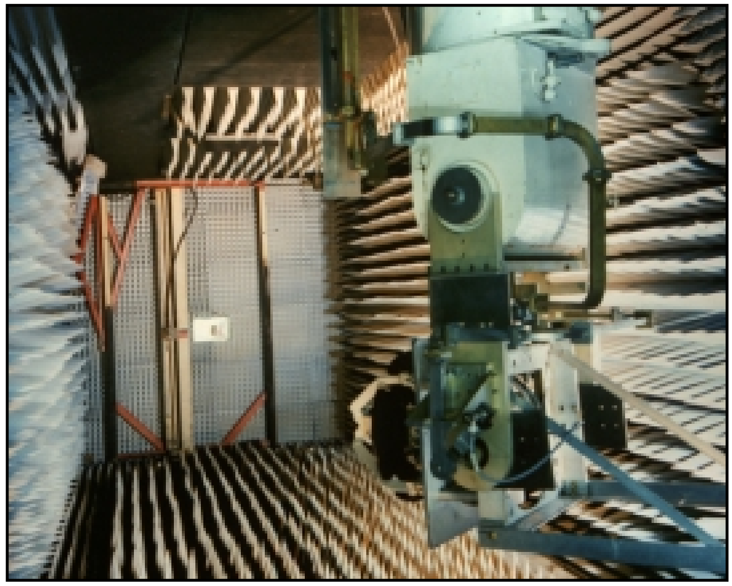
CONTACT:

G. Cowart • Code 5730 • (202) 404-7650

LOCATION:

Bldg. 210, Rm. 1142 • NRL, Washington, DC

Low-Power Anechoic Chamber



Low-Power Anechoic Chamber for EA techniques development

FUNCTION: Develops and evaluates the effectiveness of electronic attack (EA) techniques against antiship cruise missiles. All terminal EAs programmed in the active AN/SLQ-32(V) area threat libraries are developed, tested, and evaluated in this facility in open- and closed-loop test configurations. Measures of effectiveness of the EA waveforms against the missiles are obtained through closed-loop testing.

INSTRUMENTATION: EA equipment includes operational Fleet techniques generator, advanced waveform generators including capability to do cross-pole jamming and programmable fiber-optics delay line to replicate frequency agile return signals delayed in time and closing at antiship missile velocities. The facility instrumentation assets include Astro-Med strip-chart recorder, X/Y plotter, radio frequency (RF) spectrum analyzer, oscilloscopes, RF power meter, and microwave sources for generating target signatures, including traveling wave tube (TWT) and solid-state, microwave, and wide-band amplifiers.

DESCRIPTION: The hardware-in-the-loop facility is instrumented to test antiship missiles operating in the I and J band of the frequency spectrum with the capability for up to two targets, such as a ship and chaff, in the scenarios. The two targets alternatively can also be implemented to simulate two ships, each having an onboard active electronic warfare (EW) system. Missile radar seekers are mounted on a two-axis pedestal that allows closed-loop evaluation in the azimuth and elevation planes. The engagement and associated kinematics are developed using computer-controlled interactions between the pedestal, a fixed and a moving horn. The fixed horn is implemented using synthetic line of sight. Signals radiated in the direction of the missile radar seeker simulate targets as seen by the missile seeker, including pulse-by-pulse seeker antenna patterns, ship cross-sectional area, range attenuation, and scintillation effects. EA returns are radiated to also include the effects of seeker antenna patterns, range attenuation, and realistic jamming-to-signal ratios. The missile autopilot aerodynamics modeling is done in real time by using an Applied Dynamics ADRTS dynamic simulation system with the capability of collecting and displaying more than 50 channels of data. The antiship missile model library includes many of today's threats.

CONTACT:
P. Grounds • Code 5740 • (202) 404-2814
LOCATION:
Bldg. 210, Rm. 1333 • NRL, Washington, DC

Search Radar ECM/EA Simulator (SRES)

Search Radar ECM/EA Simulator (left) and coastal defense radar (right)

FUNCTION: This facility tests the effectiveness of electronic countermeasures/electronic attack (ECM/EA) equipment and techniques for jamming airborne search and targeting radars.

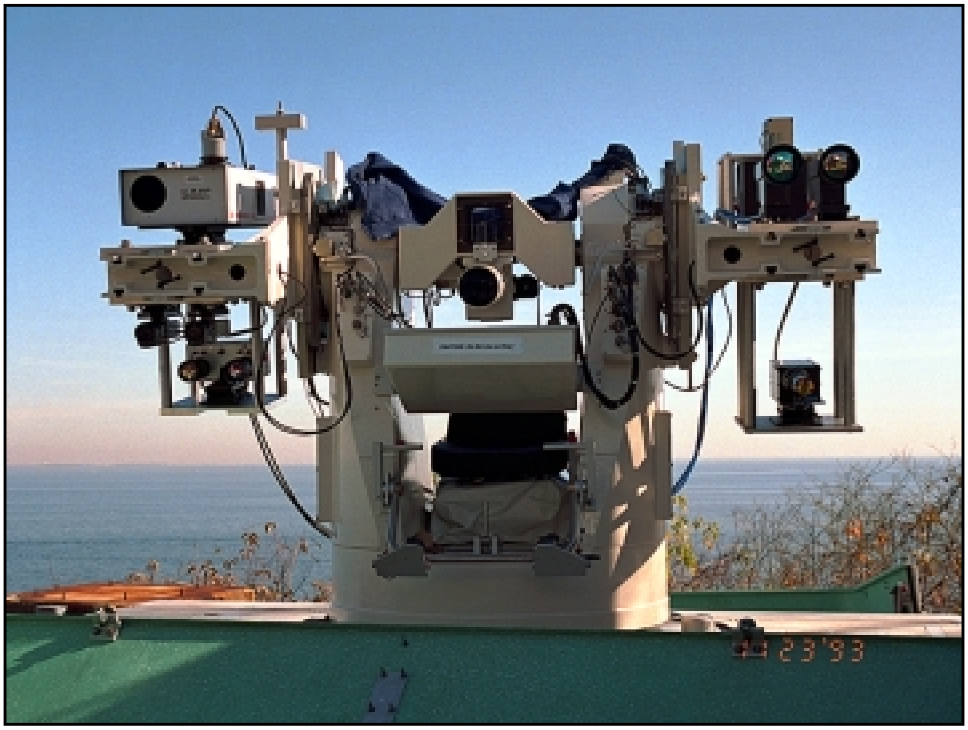
INSTRUMENTATION: Resident EA equipment includes noise sources, false target generators, and ALQ-99 and SLQ-32 techniques generators. Radar equipment includes a coastal defense radar system, two PPIs, A and B scopes, and other radar receivers. Additional data recording devices are a line printer for simulator data hard copy, photographic and S-VHS video recording of radar displays, and a microwave spectrum analyzer with camera.

DESCRIPTION: The Search Radar EA Simulator (SRES) is an electronic laboratory for developing EA techniques and for testing EA equipment. It simulates the engagement between an airborne threat search radar and a group of surface ships and aircraft that use EA as part of their defense. The simulation generates radio frequency (RF) signals in real time that would be present in the threat radar receiver as measured from the radar echoes and EA. These signals are processed by the radar receivers and presented on radar displays for man-in-the-loop determination of EA effectiveness. An effective EA prevents the radar operator from determining the preferred target's location.

The simulator is housed in an RF-shielded room with both 60 and 400 Hz electrical power. A computer controls microwave attenuators and switches to generate the simulated radar signals. A separate Pentium personal computer controls the simulation through a graphical user interface for scenario entry. SRES uses human radar operators to achieve actual man-in-the-loop target determination and EA effectiveness.

CONTACT:
P. Grounds • Code 5740 • (202) 404-2814
LOCATION:
Bldg. 210, Rm. 1138 • NRL, Washington, DC

Electro-Optics (E/O) Mobile Laboratory



Electro-Optics Mobile Laboratory

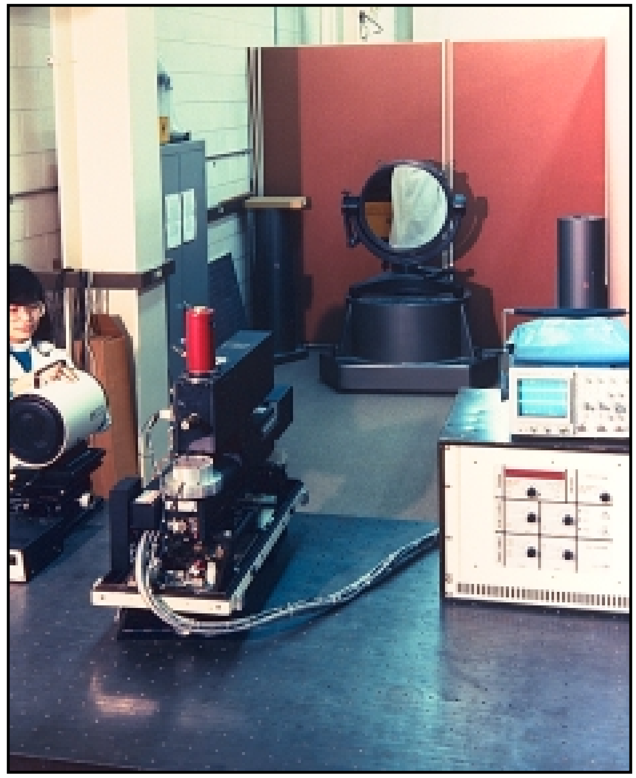
FUNCTION: Provides quantifiable infrared (IR) spatial and spectral radiometric measurements of various types of targets. Typical targets are ships, aircraft, or IR decoy.

INSTRUMENTATION: Electro-Optics (E/O) Mobile Laboratory test equipment includes weather, ranging, video, and electro-optical instruments. Radiometric and imaging instruments are calibrated and characterized before each test. Equipment currently in use includes: two Bomem DA2 series FTIR interferometer spectrometers (2 to 12 μm), CI Systems SR-5000 (3 to 12 μm), Minarad SA-1000 circular variable filter radiometer (1.4 to 5.9 μm), two 2100 Inframetric imagers (dual band), and other imagers. Calibrations are verified in the field with IR blackbody sources to assure accuracy and consistency.

DESCRIPTION: The E/O Mobile Laboratory is a specially modified, fully instrumented vehicle and a trailer-configured precision tracking mount. This facility provides the work space, storage, and power for instrumentation racks and their operators. Front-end optics and electronics are boresighted on the Kineto tracking mount to provide stable platform. The mount provides motions of 640° azimuth and 90° elevation at up to 60°/s. Full velocity can be reached within 1 s from a standing position with a full load of 300 lb on each arm and the operator. This mobile laboratory is outfitted for visual and IR imagery, which can be used for tracking or spatial measurements. High-precision IR radiometers and interferometers provide calibrated measurements in both 3 to 5 μm and 8 to 12 μm bands. A full data acquisition system permits archiving and prompt data reduction.

CONTACT:
R. Evans • Code 5750 • (202) 767-3337
LOCATION:
Bldg. 210 (rear) • NRL, Washington, DC

Infrared/Electro-Optical Calibration and Characterization Laboratory



Infrared/Electro-Optical Calibration and Characterization Laboratory

FUNCTION: Enables the optical characterization of infrared (IR) materials and precise calibration of IR radiometric and spectroscopic instrumentation.

INSTRUMENTATION: Included are state-of-the-art instruments and devices. Calibration is carried out with precision IR calibration sources and a 24-in. diameter, 200-in. focal length, off-axis collimator. IR paints and materials are characterized by several instruments such as a Perkin-Elmer spectrophotometer (transmittance and specular reflectance) and two Bomem FTIR integrating spheres for visual and IR bands, giving values for total and diffuse reflectance. These calibrations can be carried out at several ambient temperatures using a Tenny environmentally controlled chamber.

DESCRIPTION: The Infrared/Electro-Optical Calibration and Characterization Laboratory is an essential element of NRL IR signature measurement and signature control programs. Naval Sea Systems Command-supported ship signature measurement and ship decoy development programs rely on this laboratory for accurate calibration of instruments such as interferometer spectrometers, circular variable filter radiometers, and IR imaging radiometers. For IR signature control programs, the facility provides the capability of characterizing the surface emissive and reflective properties of IR paints and materials. Measurements are made on transmittance, specular reflectance, diffuse reflectance, and bidirectional reflectance.

CONTACT:
R. Evans • Code 5750 • (202) 767-3337
LOCATION:
Bldg. 210, Rm. 1143 • NRL, Washington, DC

Infrared (IR) Missile Simulator and Development Laboratory

Infrared Missile Simulator and Development Laboratory

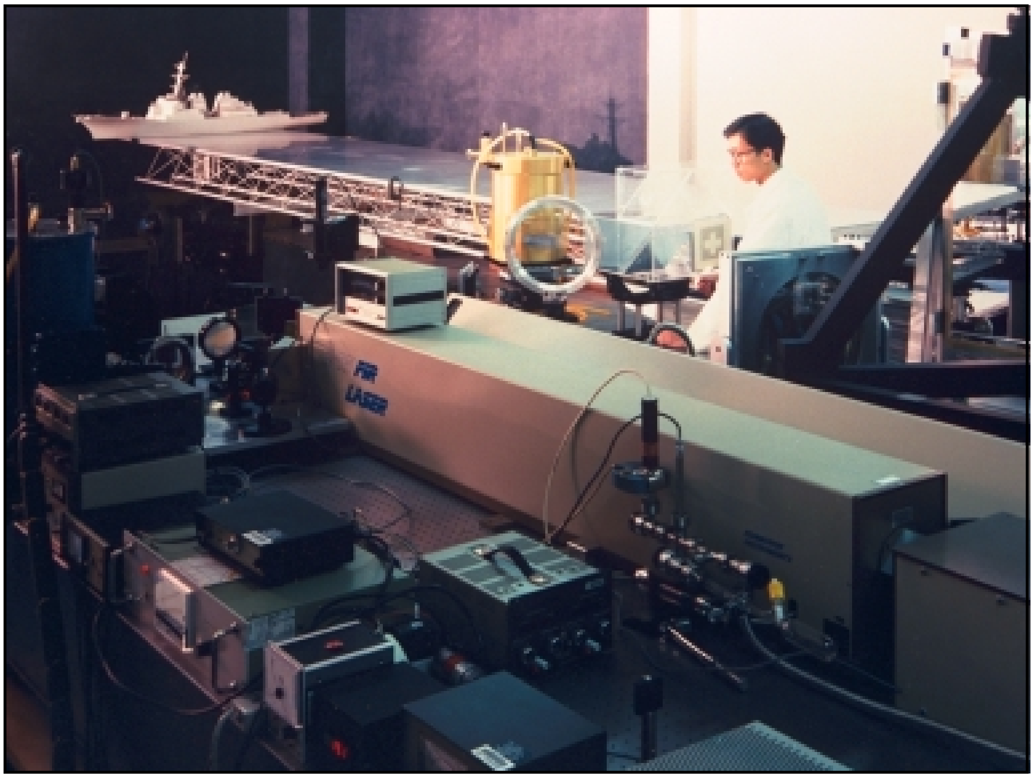
FUNCTION: Determines the effectiveness of ship-based infrared (IR) decoys and IR laser countermeasure (CM) systems against the IR guided antiship missiles (ASM). Develops performance bounds of IR ASMs to detect and engage both conventional and signature-reduced U.S. surface platforms and to evaluate the performance of various IRCM techniques from research and development to development test (DT)/operational test (OT).

INSTRUMENTATION: An extensive array of optical and electronic analysis equipment supports the development, test, and operation of the IR simulators. Test and analysis of much of the electronics is accomplished through custom interfaces coupled to portable computer-based data acquisition subsystems. Software development facilities are a major feature of the simulators that use both high-level and assembly-level code for real-time operations. A high-performance emulation environment makes development of this complex code possible.

DESCRIPTION: The IR Missile Simulator and Development Laboratory includes IR seeker simulators and a fully equipped laboratory for sensor evaluation, processor design and development, flight hardware assembly, algorithm design, and data analysis. The aircraft-mounted systems use fiber-optic communications between wing pod and the instrumentation/display inside the aircraft. This provides low noise on all data channels. The simulator systems contain an integrated data system for analysis of extensive field trials and allow ready visualization of both the actual tests and post-test data reduction. One simulator is a reprogrammable system permitting evaluation of multiple threats. Detector configurations and algorithms are changed to approximate threats. Another flyable simulator supports research on imaging IR seekers. The large system gimbal accommodates newly developed imaging IR cameras. By using commercial image processing boards and an array of microprocessors, a complete missile seeker system with exceptional flexibility to incorporate new algorithms and IRCCM approaches is obtained.

CONTACT:
R. Evans • Code 5750 • (202) 767-3337
LOCATION:
Bldg. 210, Rm. 1219 • NRL, Washington, DC

Scale Model Analysis Facility (SMAF)



Scale Model Analysis Facility

FUNCTION: Uses reduced-scale models and a submillimeter (SMM) laser and detection system to measure and analyze the radar cross section (RCS) of ships and ship systems.

INSTRUMENTATION: The radar analog is a homodyne system with a continuous wave SMM laser transmitter and a liquid helium cooled, bolometer receiver. Target translation and orientation are with a high-precision, six degree-of-freedom (DOF) positioning stage. A high-quality SMM absorption material reduces the background signals in the anechoic chamber. A simulated sea surface adds the multipath effect between the target and the sea. A stereo lithography system adds to the capability of model construction.

DESCRIPTION: The Scale Model Analysis Facility (SMAF) is an efficient method of measuring and analyzing the RCS of objects through an accurate scaling of the object, the radar system, and the environment. For ship models, mid X-band studies require SMAF to operate in the SMM region. Lower scaling ratios permit more detailed study of structures, such as radars or weapon systems. The SMAF range includes a SMM radar analog and an anechoic chamber. During measurement, the model is illuminated by a narrow SMM beam, while translating in a raster pattern in the anechoic chamber. Backscattered energy is collected as a function of elevation and cross range until the entire model has been swept. Processed data produce high-resolution radar images from which locations in cross range and elevation, magnitudes, and angular persistencies of the major scattering centers on the target can be accurately assessed.

CONTACT:
R. Evans • Code 5750 • (202) 767-3337
LOCATION:
Bldg. 210, Rm. 1460 • NRL, Washington, DC

Secure Supercomputing Facility (SSF)

Secure Supercomputing Facility

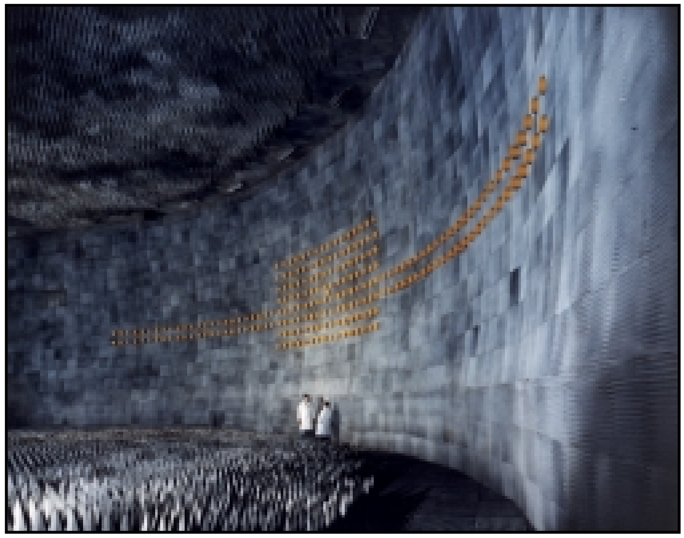
FUNCTION: Provides NRL, the Navy, and DoD with a high-speed, large-memory computation facility for classified projects. Throughput is comparable to a dozen Cray XMPs with large solid-state disks and can complete a year of VAX 11/780 runs within a matter of minutes to seconds. The SSF primarily addresses requirements for GENSER Secret, Top Secret, and material requiring special controls.

INSTRUMENTATION: Secure Supercomputing Facility (SSF) visitors are accommodated in spaces featuring high-performance workstations, X/terminals and PCs, and a complement of printers. A rich set of productivity tools are available including: X/windows and Motif graphical user interfaces, a full set of UNIX network connectivity tools, industry standard editors, UNIX tools and debuggers, high-performance Math libraries, parallel and distributed programming tools, data visualization, and multimedia tools.

DESCRIPTION: The SSF centerpiece is a 16-processor SGI Power Challenge with each processor achieving 300 Mflops, and with 16 GB of physical memory and 24 GB virtual memory. Local disk storage (>70 GB) uses removable Winchester disk cassettes. The facility's computational capability is supplemented by an SGI Origin 2000 system with 16 advanced processors that each achieve 400 Mflops and 8 GB physical memory. The SSF includes a fully automated, extensible network file server with a storage of >500 GB. Access to the SSF is restricted to workspaces within the controlled perimeter of the Tactical Warfare Division (TEWD) building complex. Normally, the SSF runs tasks through GENSER Secret and may be accessed workspaces via the TEWD network. For more highly controlled projects, the SSF Power Challenge and vault enclosure become dedicated to the particular project. Each project uses its own exclusive complement of removable disk cassettes as well as system and application software.

CONTACT:
R. Evans • Code 5750 • (202) 767-3337
LOCATION:
Bldg. 210, Rm. 2448 • NRL, Washington, DC

Central Target Simulator (CTS) Facility



Central Target Simulator Facility

FUNCTION: A high-performance, hardware-in-the-loop simulator for real-time closed-loop testing and evaluation of electronic warfare (EW) systems and techniques to counter the antiship missile threat to the U.S. Navy in the 8.0 to 18.0 GHz frequency range. Tests use actual missile hardware and closure rates, enabling test results to be reported in the form of hit/miss distances. In addition, open-loop characterization tests evaluate the capabilities of threat systems and contribute data to the threat simulator validation process.

INSTRUMENTATION:The facility uses general laboratory instrumentation and recording equipment to display and capture information relative to the tests being conducted. The simulation computer stores pertinent information from the scenario, along with 16 analog channels and 32 digital bits captured from the missile radar. A coupling capacitor voltage transformer (CCTV) system allows remote displays to be viewed in the control room and throughout the facility, with recording via two VCRs. Communication is provided by a dedicated audio intercom.

DESCRIPTION: The Central Target Simulator (CTS) Facility is built around a 114 ft × 127 ft × 38 ft high shielded anechoic chamber. A spherical array of 225 dual-polarized antennas is used to simulate the radio frequency (RF) environment that the missile encounters in an engagement. Two feed networks distribute time and/or space coincident signals. The RF generation subsystem is synchronized to the missile radar in time and frequency. State-of-the-art modulation equipment replicates the characteristics of ship and decoy echoes, correctly triggering target discriminants. External inputs allow jamming signals or waveforms to be included. Missile hardware is mounted 75 ft from the array on a three-axis flight motion simulator. The loop between the missile and the facility is closed through a Silicon Graphics Challenger computer. This computer is programmed with a 6-DOF aerodynamics/autopilot model that interacts with the guidance hardware in response to the RF stimuli. Simulations run in real time at update rates of up to 200 Hz. A battery of open-loop characterization tests is used to evaluate the performance of the missile radar subsystems, identifying design features, vulnerabilities, or limitations for potential exploitation by EW tactics and techniques.

CONTACT:
B. Edwards • Code 5760 • (202) 767-6470
LOCATION:
Bldg. 210, Rm. 1239 • NRL, Washington, DC

Flying Electronic Warfare Laboratory

Flying Electronic Warfare Laboratory

FUNCTION: Provides NP-3D aircraft host platforms for Effectiveness of Navy Electronic Warfare Systems (ENEWS) Program antiship missile (ASM) seeker simulators used for electronic warfare (EW) effectiveness assessment in an at-sea environment. This capability provides the Navy's RDT&E and operational communities with unique assets and realistic methods for evaluating surface Navy EW systems.

INSTRUMENTATION: Two NP-3D aircraft are configured to carry the simulators. These simulators represent a large cross section of the threat missile systems available worldwide and are derived from other programs or are hardware systems modified to represent various threat seekers. All of the simulators are unique, one-of-a-kind systems with the associated instrumentation tailored to the individual simulator. GPS and data link systems allow the collection of aircraft and ship's position information for ground truth determination.

DESCRIPTION: The Flying Electronic Warfare Laboratory provides ASM threat representation through the adaptation of a host of missile seeker simulators. Operational testing against ship's EW assets is enhanced through the unique ability to provide real-time feedback of the effectiveness of electronic attack (EA) responses to the threat seeker's stimuli. Fifteen different simulators representing various ASM threat types are available as part of the ENEWS Program. Up to eight simulators can be operated simultaneously to exercise the on/off-board EW assets being tested. Internally mounted equipment racks contain seeker control panels, data displays, data acquisition systems, and communications systems that are organic to each simulator. The Laboratory supports RDT&E and operational activities on a worldwide basis, providing EW testing support to U.S. and NATO programs and those of individual countries.

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B. Edwards • Code 5760 • (202) 767-6470
LOCATION:
Hangar 305 • Naval Air Warfare Center, Patuxent River, MD

MATERIALS

SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE

Code 6030 – Laboratory for Structure of Matter

Code 6100 – Chemistry Division

Code 6300 – Materials Science and Technology Division

Code 6400 – Laboratory for Computational Physics and Fluid Dynamics

Code 6700 – Plasma Physics Division

Code 6800 – Electronics Science and Technology Division

Code 6900 – Center for Biomolecular Science and Engineering

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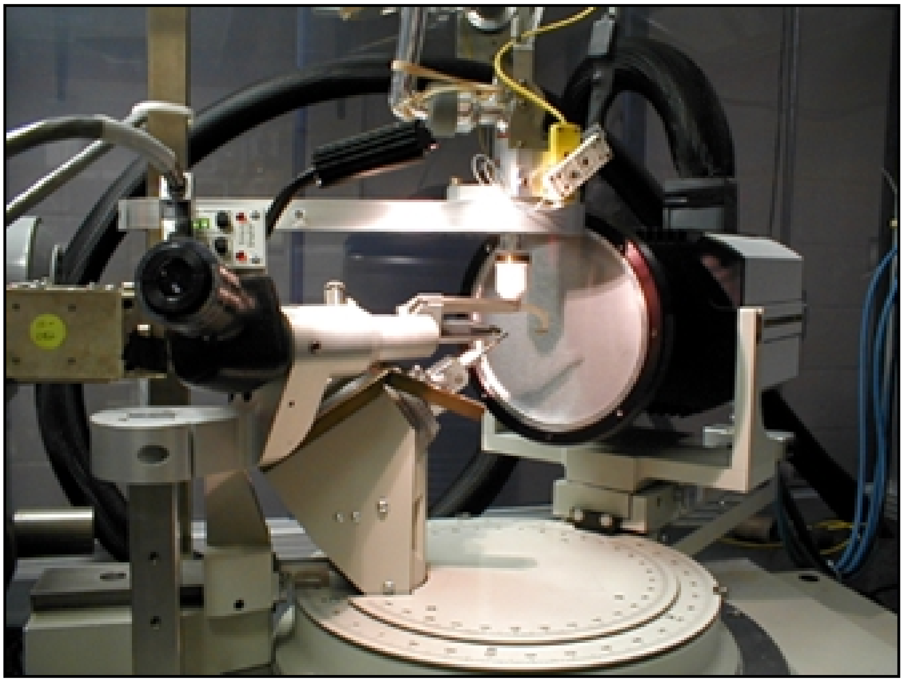
Laboratory for Structure of Matter

- Automatic X-ray Diffractometers
- Atomic Force Microscope

Automatic X-ray Diffractometers



Bruker 6000 CCD X-ray detector mounted on a platform goniometer

FUNCTION: Carries out atomic resolution single-crystal X-ray diffraction analyses. Capabilities exist to examine a wide range of materials from small inorganic molecules to macromolecular biological compounds.

INSTRUMENTATION:

• Bruker 6000 CCD area detector mounted on a three-circle goniometer. This equipment is coupled to a rotating anode Cu-Kα X-ray source using high brilliance Gobel mirror X-ray optics.

• Bruker 1000 CCD area detector mounted on a four-circle goniometer using a sealed tube Mo-Kα X-ray source and an incident beam graphite monochromator.

• Bruker P4 serial detector on a four-circle goniometer using a sealed tube Cu-Kα X-ray source and an incident beam graphite monochromator.

DESCRIPTION: The site includes laboratories for sample preparation and purification. Laboratory facilities are also provided for crystal growth. Three automated X-ray diffractometers are available for data acquisition, all of which may be operated over a range of sample temperatures (22° to –180° C). High-speed computational facilities are in place for structure solution and analyses.

CONTACT:
C. George • Code 6030 • (202) 767-3463
LOCATION:
Bldg. 35, Rm. 206 • NRL, Washington, DC

Atomic Force Microscope

Main components of the atomic force microscope

FUNCTION: The atomic force microscope (AFM) is a surface scanning instrument that detects surface topography with a lateral resolution of 0.5 to 1.0 nm and a vertical resolution of 0.1 to 0.2 nm.

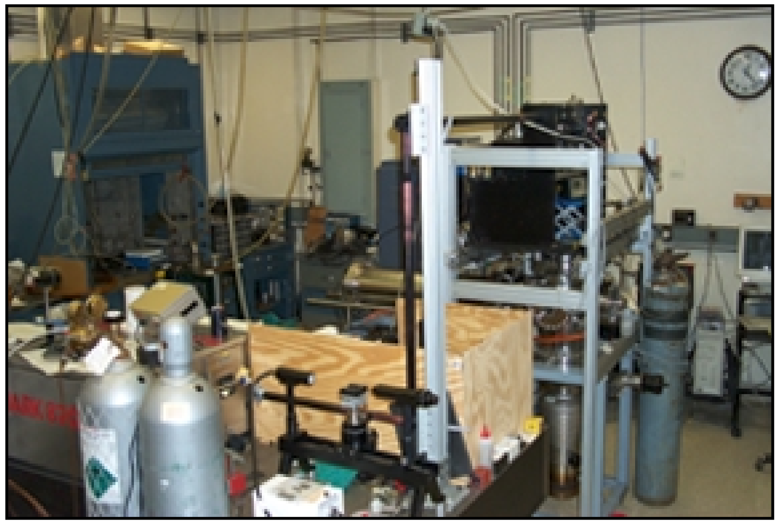
DESCRIPTION: Our AFM is currently dedicated to the study of mechanisms involved in the growth of single crystals of biologically active macromolecules suitable for X-ray diffraction studies. This instrument scans a sharp stylus located at the end of a flexible cantilever over the crystal surface. Surface images are obtained of dynamically growing crystals that have been placed in a fluid cell. The concentrations of the various species in solution and temperature are varied to directly observe the effects on the crystal growth process. The goal is to reproducibly grow crystals with few defects.

CONTACT:
J. Konnert • Code 6030 • (202) 767-3267
LOCATION:
Bldg. 35, Rm. 207 • NRL, Washington, DC

Chemistry Division

- Chemical Analysis Facility
- Corrosion Engineering and Coatings Characterization Facilities
- Marine Corrosion Facility
- Nanometer Characterization/Fabrication Facility
- Synchrotron Radiation Facility
- Ex-USS *Shadwell* Advanced Fire Research Ship
- Fire Research Enclosure
- Fire Research Test Bed
- Large-Scale Damage Control Facility

Chemical Analysis Facility



Chemical Analysis Facility

FUNCTION: Uses state-of-the-art instrumentation for trace qualitative and quantitative analysis of organic and inorganic compounds, and biomolecules from gas, liquid, and solid samples. Principal functions of the facility include analyzing samples of environmental importance, ranging from the atmospheres of submarines to polycyclic aromatic hydrocarbons in harbor sediments, and characterizing synthetic products and materials (such as polymers) produced by novel methods such as plasma deposition.

INSTRUMENTATION: Gas chromatographs with flame ionization, thermal conductivity, and electron capture detectors; liquid chromatographs with UV-visible, fluorescence, and mass spectrometer detectors; capillary electrophoresis instruments with UV-visible and conductivity detectors; a thermal desorption/gas chromatograph/mass spectrometer; a gas chromatograph/ion trap tandem mass spectrometer; a membrane introduction/ion trap tandem mass spectrometer; electrospray triple quadrupole and electrospray ion trap tandem mass spectrometers; a matrix-assisted laser desorption time-of-flight mass spectrometer; an imaging two-step laser desorption laser ionization time-of-flight mass spectrometer; graphite furnace atomic absorption and ICP emission spectrometers; and infrared, UV-visible, and NMR spectrometers.

DESCRIPTION: The facility includes instrumentation for the characterization of samples of many types using a variety of analytical techniques. Environmental samples (air, water, and sediment) are prepared by techniques such as solid-phase micro-extraction, solid-phase extraction, membrane introduction, liquid extraction, and thermal desorption. Quantitative and qualitative analytical information is provided by gas chromatography, gas chromatography/mass spectrometry, liquid chromatography, liquid chromatography/mass spectrometry, capillary electrophoresis, infrared spectrometry, UV-visible spectrophotometry, atomic absorption spectrometry, and atomic emission spectrometry. More detailed information about molecular structures can be obtained by NMR spectrometry, isotope ratio mass spectrometry, matrix-assisted laser desorption mass spectrometry and electrospray tandem mass spectrometry. The capability to characterize the spatial location of molecules on surfaces, while maintaining molecular weight information, has been added in a new imaging laser desorption/laser ionization mass spectrometer. Synthetic samples are handled in a similar fashion using many of the same techniques.

CONTACT:
J. Callahan • Code 6115 • (202) 767-0719
LOCATION:
Bldg. 207, Rms. 248-250 • NRL, Washington, DC

Corrosion Engineering and Coatings Characterization Facilities

Corrosion Engineering and Coatings Characterization Facilities

FUNCTION: Performs materials corrosion engineering and prevention studies, cathodic protection design, marine coatings characterization, electrochemical systems, seawater sensor systems, and materials failure analysis related to marine environments. Additionally, laboratories support efforts at the NRL Center for Corrosion Science and Engineering located in Key West, Florida.

EQUIPMENT: Electrochemical testing equipment for ac and dc measurements; Kelvin probe; Fourier transform infrared spectroscopy; gas chromatography/mass spectroscopy; Zeta potential measurement system; PRT member on beam line X11 at the National Synchrotron Light Source; fuel cell test station; X-ray photoelectron spectroscopy; and X-ray fluorescence

DESCRIPTION: Specialized analytical laboratories determine the mechanisms of materials degradation and develop coatings technology for Naval systems. Seawater effects on materials are studied to understand fundamental physical properties of the electrochemical reactions, mechanisms of materials degradations, and the methodology for materials preservation and protection. The facilities include basic electrochemical test laboratories, surface chemical analysis, organic coatings properties measurement, mechanical failure analysis, stress corrosion cracking/hydrogen effects instrumentation, analytical analysis, and corrosion properties measurement. Marine coatings laboratories enable the analysis of barrier coating properties, surface preparation scenarios, application, and performance testing. Electrochemical facilities enable the theoretical understanding of interfacial processes and surface chemistry and use the information gained to guide materials development, improve material performance, and reduce maintenance costs.

CONTACT:
K. Lucas • Code 6130 • (202) 767-0833
LOCATION:
Bldg. 3, Rm. 261 • NRL, Washington, DC

Marine Corrosion Facility

Marine Corrosion Facility

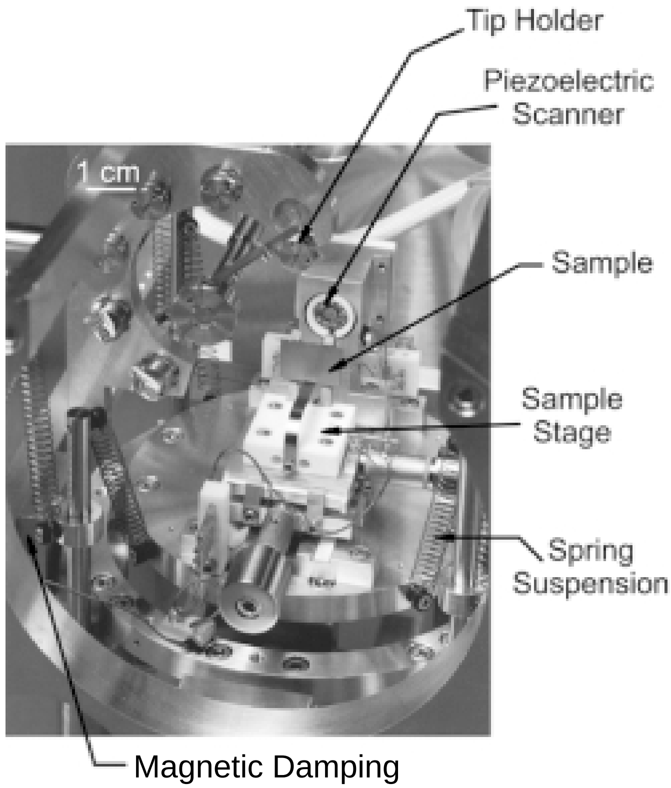
FUNCTION: Conducts RDT&E in direct support of current and 21st century Fleet requirements concerning seawater materials performance, corrosion behavior, and marine coatings technology.

CAPABILITIES: Cathodic Protection/Signature Analysis Physical Scale Modeling Facility; coatings testing and application facilities; controlled Atmosphere Coatings Application Chamber; weatherometer and Environmental Effects Laboratory; Heat Exchanger Test Facility; Corrosion, Metallography, and Electrochemistry Laboratory; seawater flow loop and low-velocity exposure troughs; 5-30-kt seawater flow channel; 55,000 and 110,000 gallon modeling tanks; 0-1000 psi pressurized seawater flow loop; 800-ft instrumented sacrificial anode test pier; UV and salt spray environmental test chambers; atmospheric exposure test racks; cantilever beam SCC/hydrogen effects testing; and two remotely operated vehicles.

DESCRIPTION: The Marine Corrosion Facility is located on the Naval Air Station, Trumbo Point Annex, adjacent to Key West, FL. The laboratory has an unparalleled database for natural seawater exposure testing and marine-related materials evaluation. It receives a plentiful, unpolluted supply of natural undisturbed Gulf of Mexico seawater throughout the year. The tropical climate is ideally suited for marine exposure testing and provides minimal climatic variation, with a stable biomass throughout the year. The laboratory has more than 1000 ft of waterfront access, natural "blue" ocean-quality seawater access, a 2500-ft^2 atmospheric test site, and more than 14,000 ft^2 of laboratory facilities.

CONTACT:
E. Lemieux • Code 6136 • (305) 293-4214
LOCATION:
Bldgs. F-14 and F-15, Naval Air Station • NRL, Key West, FL

Nanometer Characterization/Fabrication Facility



Close up view of a scanning tunneling microscope (STM) used for the study of semiconductor surfaces and interfaces

FUNCTION: Characterizes the nanometer scale of biological, chemical, physical, electronic, and mechanical properties of surfaces and thin films using scanning probe microscopies/spectroscopies, and a variety of complementary surface analysis techniques. The limits of materials miniaturization are explored by using the new microscopes to fabricate and manipulate surface structures of nanometer size. This technology is used to investigate new chemical, biological, and magnetic sensors, electronic devices, and nanoscale materials.

INSTRUMENTATION: NRL-built ultra-high-vacuum (UHV) STM/S facilities; Park Scientific Instruments AutoProbe UHV STM/AFM integrated with the NRL Molecular Beam Epitaxy (MBE) Epicenter; Nanoscope IIIa multimode AFM; Digital Instruments Bioscope AFM integrated with a Zeiss Axiovert 100 inverted optical microscopy; and Micromeritics ASAP 2010 Accelerated Surface Area and Porosimetry System and Chemisorption Analyzer.

DESCRIPTION: Scanning tunneling microscopy/spectroscopy (STM/S) enables observation of the surface topography, chemical reactivity, and electronic structure of conductive substrates with atomic-scale resolution. The atomic force microscope (AFM) provides nanometer-scale resolution of surface topography, mechanical properties, and tip-surface interaction forces on both conductive and insulating substrates. The tip-surface interaction forces, including frictional forces, can be measured with nanonewton (single chemical bond) precision. A new ultra-high vacuum system for nanomanipulation and nanoprobe characterization is also planned.

CONTACT:
R. Colton • Code 6170 • (202) 767-0801
LOCATION:
Bldg. 207, Rm. 201 • NRL, Washington, DC

Synchrotron Radiation Facility

Instrumentation and chamber on the NRL X24C beamline at the National Synchrotron Light Source, Brookhaven National Laboratory

FUNCTION: Studies the effects of ultraviolet and X rays on solids and calibrate X-ray optics, detectors, and instruments.

DESCRIPTION: Research focuses on applying X rays to chemical and structural analysis of electronic and optical materials. Structural dynamics are monitored by diffraction carried out at the National Synchrotron Light Source (NSLS) or at major laser plasma X-ray sources, over time scales from picoseconds to hours. Synchrotron and pump-probe laser techniques elucidate the electronic structure of the ground state, transiently excited states, and photo-transformed states in insulators, semiconductors, and molecular films.

INSTRUMENTATION:
- Beamline X23B provides intense, focused X-ray fluences from 3 to 11 keV with an energy resolution of 3 $\times 10^{-4}$. Experimental equipment includes a four-circle Huber diffractometer and apparatus for transmission, fluorescence, and electron EXAFS.
- Beamline X24C provides intense, focused ultraviolet and X-ray fluences from 1 to 1800 eV with an energy resolution of 1 $\times 10^{-3}$ (delta E/E). There are three large ultra-high vacuum experimental chambers; a photoemission chamber, a reflectometer, and a space science and plasma diagnostic instrument calibration facility.
- Beamlines X11A and X11B provide intense focused and unfocused x-ray fluence from 2 to 35 keV with an energy resolution of 2 x 10^{-4}. Experimental equipment includes apparatus for transmission and fluorescence EXAFS.
- Beamline U4B provides intense focused ultraviolet and fluence from 80 to 1200 keV with an energy resolution from 10^{-3} to 10^{-4}. Equipment includes UHV photoemission and reflectance experimental chambers.

CONTACT:
J. Rife • Code 6177 • (202) 767-4654 or B. Ravel • Code 6134 • (202) 767-5947
LOCATION:
Bldg. 75, Rm. 314 • NRL, Washington, DC

Ex-USS Shadwell *Advanced Fire Research Ship*

Ex-USS *Shadwell*

FUNCTION: Conducts full-scale fire/damage control experiments in a shipboard environment. This test platform can provide an integrated picture of the interactions of man, equipment, materials, tactics, doctrine, and systems in the development of fire protection/damage control concepts and technology, including the use of chemical simulants.

INSTRUMENTATION: The facility has extensive sensor and analytical sampling capabilities for measuring temperature, pressure, smoke obscuration, fluid flow, radiation flux, and total heat flux. There are video recorders for documentation of the fire tests and significant computing facilities for data collection, manipulation, and presentation. There is a 1-gigabit blown fiber network, which is tied into the data system, with 12 node rooms for input, output, and control of ship sensors and functions. This provides video coverage throughout the ship.

DESCRIPTION: Ex-USS *Shadwell* (LSD15) has an overall length of 457 ft, beam of 72 ft, and full load displacement of 9000 tons. As a test bed, the ship contains one pressure zone to study smoke management, including a collective protection system (CPS) that has been created on all levels forward of frame 35. Selected ship systems that are important to fire protection and damage control, such as ventilation, electrical power, fluid distribution, fire mains, fire pumps, and internal communications, have been reactivated. The ship has undergone major automation upgrades to its damage control systems. There is a high-pressure fine water mist system over all decks forward of frame 35.

CONTACT:
F. Williams • Code 6180 • (202) 767-2476
LOCATION:
Little Sand Island, Mobile Harbor • NRL, Mobile, AL

Fire Research Enclosure

Submarine Fire Research Facility (FIRE I)

FUNCTION: Simulates submarine fires, enclosed aircraft fires, and fires in enclosures at shore facilities.

INSTRUMENTATION: The facility has over 200 sensors measuring pressure, temperature, radiation, total heat flux, and fire byproducts. The data are collected, analyzed, and displayed in real time. Nitrogen-suppression pipes are embedded along the chamber walls. Thermocouples in the skin of the chamber record the effect of heat transfer to the chamber wall. The size and complexity of FIRE I require intricate safety considerations with built-in interlock systems. There are several television cameras to visually record the test fires.

DESCRIPTION: FIRE I is a pressurizable, 324-m^3 (11,400 ft^3) fire test facility that simulates a one-quarter scale submarine compartment capable of pressurization to more than 6 atmospheres. This facility is used to study large-scale confined fires under controlled conditions and test prototype equipment and firefighting agents. Two fixed fire suppression systems for enclosures—nitrogen pressurization and preliminary water mist—have been tested.

CONTACT:

R. Sheinson • Code 6185 • (202) 767-2476

LOCATION:

Chesapeake Bay Detachment • NRL, Chesapeake Beach, MD

Fire Research Test Bed

Large-Scale Fire Research Test Bed Facility

FUNCTION: Performs real-scale fire suppression experiments that simulate actual Navy platform conditions.

INSTRUMENTATION: Specific instrumentation is incorporated as a function of the particular experiment and includes sensors, gas sampling, droplet size measurements, control equipment, video recording, and fluid flow measurements.

DESCRIPTION: The test bed has two test compartments that have been used to simulate different shipboard compartments. These compartments are used to study large-scale confined fires under controlled conditions and test prototype fire suppression agents and equipment. Suppressants evaluated to date include gaseous agents, water mist, solid aerosols, and hybrids gas/powder agents.

CONTACT:

R. Sheinson • Code 6185 • (202) 767-2476

LOCATION:

Chesapeake Bay Detachment • NRL, Chesapeake Beach, MD

Large-Scale Damage Control Facility

Large-Scale Damage Control Facility

FUNCTION: Performs large-scale fire protection experiments that simulate actual Navy platform conditions. Remote control firefighting systems are also tested.

INSTRUMENTATION: Specific instruments for these test beds are incorporated as a function of the particular experiment, but include sensors, gas sampling, control equipment, mixing vessels, calibrated fuel and aqueous flow metering, and video recording. The fire test building has a large cone calorimeter for full-scale fire tests of materials and furnishings.

DESCRIPTION: The facility consists of five buildings and three test beds. Two of the buildings are for enclosed fire experiments, qualification of firefighting agents, efficacy of dispensing these agents, and control and visibility through smoke. A third building is a staging area and a fourth is for storage. The fifth building contains a hydraulics laboratory and is equipped with a full-scale shipboard balanced pressure proportioner for aqueous film forming foam. A test bed simulates the lower section of a submarine for studying bilge fires and their extinguishment. A simulated 930 m^3 (10,000 ft^2) flight test bed is used to develop fire scenarios and suppression technologies. The third test bed has two test compartments, with internal volumes of 28 and 300 m^3 (1,000 and 10,500 ft^3), which are used for fire suppression experiments.

CONTACT:

R. Sheinson • Code 6185 • (202) 767-2476

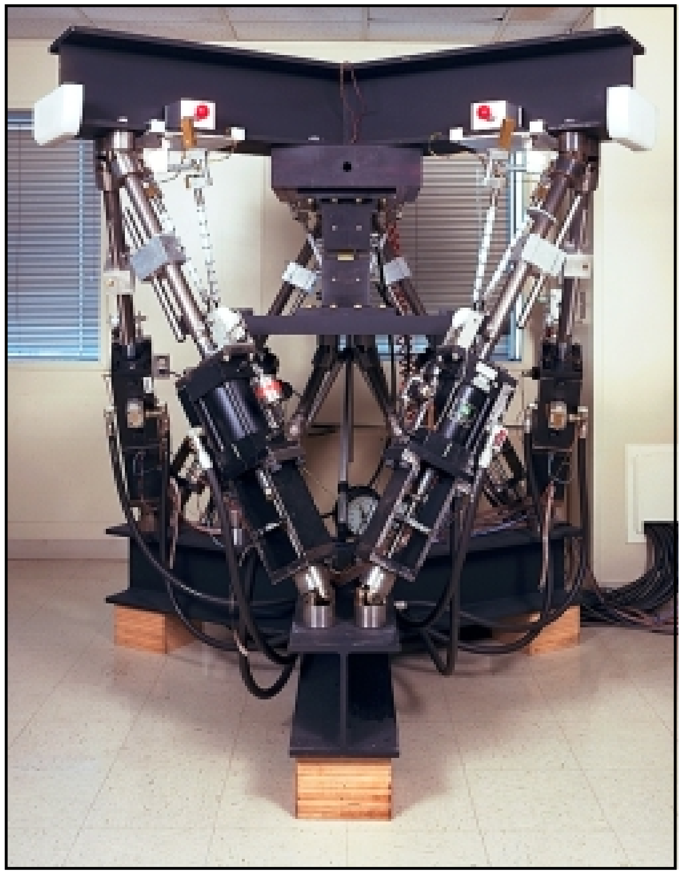
LOCATION:

Chesapeake Bay Detachment • NRL, Chesapeake Beach, MD

Materials Science and Technology Division

- Computer-Controlled Universal Material Test System
- Materials Processing Facility
- Mechanical and Thermal Experimental Facilities
- High-Power Microwave Facility
- Ion Implantation Facility
- 3-MV Tandem Van de Graff Accelerator

Computer-Controlled Universal Material Test System



Computer-Controlled Universal Material Test System

FUNCTION: Determines material properties and the structural response of components under a wide variety of loading conditions and temperatures by using computer-controlled servohydraulic load frames.

INSTRUMENTATION: The system is equipped with a 12-channel A/D module to monitor the response of the test specimen. A data acquisition system is also interfaced with the computer to support temperature measurements and additional A/D channels. Also, a Digital MINC-23 modular instrument computer is available for data collection independent of that contained in the control system. This computer can be configured by adding various modules to support a wide variety of data collection and manipulation.

DESCRIPTION: The system consists of a Micro PDP 11/23 with 512 KB of memory interfaced to a 12-channel A/D module, a 4-channel D/A module, and a test machine interface unit. These modules allow the computer to monitor test conditions and make control decisions depending on the test programming. Also, the response of the test specimen is recorded at the same time on an 11 MB hard disk. This system can operate any servohydraulic load frame and allows complicated and difficult material or component tests to be automated for greater accuracy and efficiency.

Various capacity load frames are available for testing compression, laser vulnerability, particle beam vulnerability, and for general materials and component testing.

CONTACT:

R. Badaliance • Code 6304 • (202) 767-6380

LOCATION:

Bldg. 28, Rm. 201 • NRL, Washington, DC

Materials Processing Facility

Materials Processing Facility

FUNCTION: Provides a full spectrum capability to synthesize and process materials, from small to large sizes, by a variety of methods and under varying thermal, mechanical, pressure, and rate-sensitive processes.

INSTRUMENTATION: Many of the facilities are modified versions of commercially purchased apparatus that have been adapted to the special needs of our research.

DESCRIPTION: Fully instrumented materials processing capabilities include facilities for powder production by fluid atomization, thermal evaporation, and arc erosion. These facilities offer the potential to create small particle sizes from 10 nm to 50 mm. The powder synthesis capabilities include a physical vapor deposition system designed to produce and coat submicron powders, in-situ. Facilities to process powder into bulk specimens by hot and cold isostatic pressing permit a variety of consolidation possibilities. Isothermal heat treatment facility and quenching dilatometer permit accurate determinations of phase relationships in metals. Arc melting facilities permit alloy synthesis and single crystal growth. Bulk alloys can by prepared by induction melting, while rapidly solidified metals of thin cross section can be made by splat quenching and melt spinning. The facility includes rolling mills, swagers, and wire-drawing facilities. Metal-matrix composites and surface coatings are produced in a variety of computer-controlled, physical vapor deposition systems for coating fibers and surfaces. Ceramic and ceramic-matrix composites processing facilities include a wide variety of conventional, controlled atmospheric furnaces, hot presses, ball milling apparatus and particle size determination, and sol-gel and organometallic coating processing capabilities.

CONTACT:
E. Metzbower • Code 6320 • (202) 767-2396
LOCATION:
Bldg. 42, Rm. 324 • NRL, Washington, DC

Mechanical and Thermal Experimental Facilities

Mechanical and Thermal Experimental Facilities

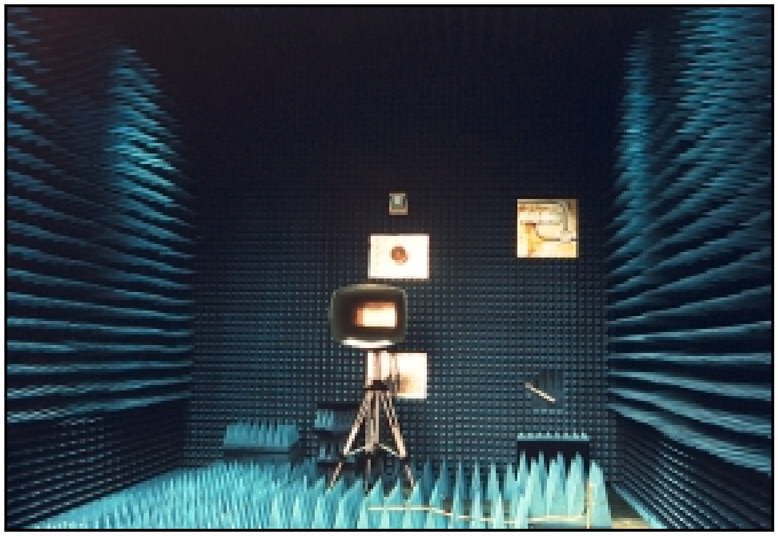
FUNCTION: Determines material behavior under cyclic, static, and complex loading conditions from ambient to high temperatures simulating the load-environmental conditions representative of service.

INSTRUMENTATION: Several of the facilities, such as creep units and special accessories, are designed and fabricated at NRL. Other facilities are purchased commercially and are modified for the advanced needs of the scientists.

DESCRIPTION: There are a number of computer-controlled, automated, servo-hydraulic mechanical testing systems, creep testing machines, high-temperature tensile and fracture toughness testing machines with controlled environmental chambers to provide either inert or regulated environments for material characterization under representative service loads and environments. Automation includes programmable feedback control systems that can simulate service spectral loads with data acquisition for simulating and characterizing the material response under complex loading conditions. Other automated systems include a multiaxial testing machine with six degrees of freedom that can determine static and dynamic properties. The facilities include systems that can apply thermal, thermomechanical, and electromechanical cyclic loads, vacuum chambers, and noncontact laser extensometers that can accurately determine material responses to temperatures up to 1500 °C. In addition, several specially made high temperature loading devices and accessories required for testing complex specimen geometries are included in the facilities.

CONTACT:
E. Metzbower • Code 6320 • (202) 767-2396
LOCATION:
Bldg. 42, Rm. 324 • NRL, Washington, DC

High-Power Microwave (HPM) Facility



High-Power Microwave (HPM) Facility

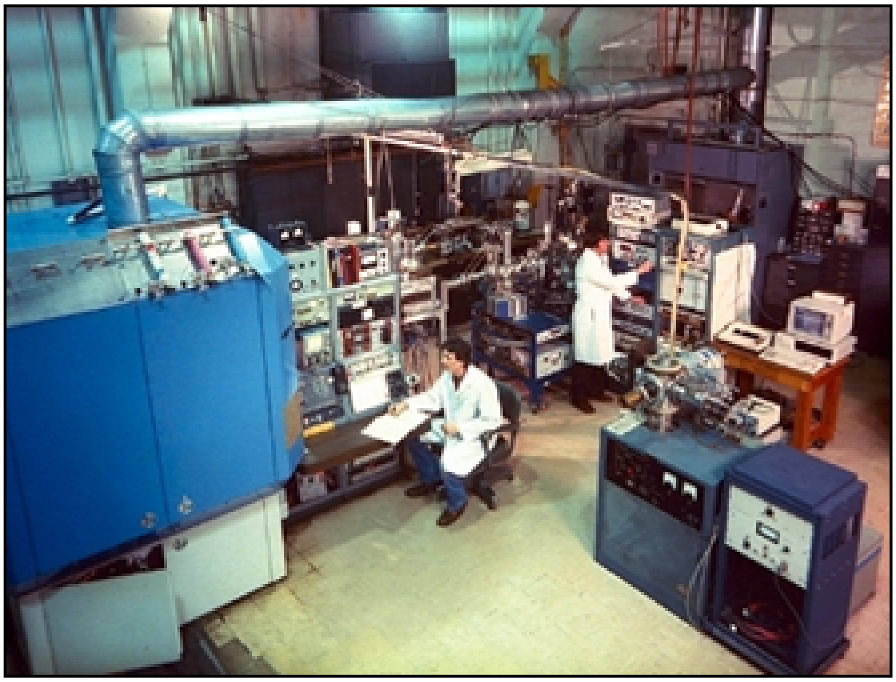
FUNCTION: Provides a state-of-the-art capability to investigate the response of systems, components, and materials to HPM radiation. Narrowband pulsed and continuous wave (CW) experiments, as well as wideband pulsed experiments, can be carried out at frequencies ranging from 0.5 to 94.0 GHz. The facility is equipped to do coupling cross-section measurements, free-field irradiation experiments on systems and components, and plasma-mediated coupling investigations of materials.

INSTRUMENTATION: The microwave sources include several high-power (1 MW peak) tunable pulsed magnetrons with frequencies ranging from 2.6 to 35.0 GHz, low-power traveling wave tubes operating from 0.5 to 8.0 GHz, 35.0 and 94.0 GHz gyrotrons (100 kW peak), and a Bournlea wideband pulser. Various standard and wideband horns are available for irradiation experiments in the anechoic chamber. A 16-channel digital data-acquisition system is used to record the response data. Scalar and vector network analyzers and an HP antenna measurement system provide the necessary support for calibration and field measurements.

DESCRIPTION: The facility is composed of four separate rooms or chambers that are approved for classified work. A large anechoic chamber (4.9 × 4.9 × 9.8 m long), with an access doorway 2.4 m wide × 3.7 m high, permits full system testing of, for example, antiship cruise missiles. Systems and other test objects are placed in the anechoic chamber and instrumented to record their functional responses in the presence of a microwave field. Various sources of microwave radiation are housed in a source room adjacent to the anechoic chamber, and the radiation is fed into the chamber through ports in the common wall. Fiber-optic telemetering of the system/material response functions is accomplished by bringing the test-object cables through the chamber floor along a trough to a control screen room where data acquisition equipment is located. Finally, a large vault room (4.9 m wide × 3.0 m high × 14.6 m long) serves as a laboratory for preparing the systems/test objects for experiments and for conducting injection, transfer-function, and other measurements.

CONTACT:
T. Weiting • Code 6330 • (202) 767-2101
LOCATION:
Bldg. 12, Rms. 15 and 113B • NRL, Washington, DC

Ion Implantation Facility



Ion Implantation Facility

FUNCTION: Modifies the surface properties of materials by bombardment with energetic ions of any elemental species. Modifications include doping and patterning of semiconductors, surface alloys that protect against wear and corrosion, formation of metastable materials, and changes on the optical constants.

INSTRUMENTATION: Varian/Exrion Model 200A2F ion implanter with 10^{-7} Torr vacuum in standard chamber; UHV chamber with 10^{-9} Torr vacuum equipped with cylindrical mirror Auger electron analyzer and coaxial 5 keV electron gun, a 5 keV sputter ion gun with rastering, and a 1 keV Kaufman ion gun for ion beam sputter deposition; a high-vacuum target chamber with a 3 kW electron beam evaporator and quartz crystal evaporation rate controller; a high vacuum chamber that includes an oven for heating liquids and a cryogenically cooled sample holder.

DESCRIPTION: The heart of this facility is a 200 kV ion implanter modified to produce intense ion beams of virtually any element in the periodic table. The standard target vacuum chamber is cryogenically pumped and equipped with a rotating water-cooled feedthrough to implant cylindrical geometry specimens up to 25 cm in diameter, a cryogenic feedthrough to cool samples down to 77 K, and a hot stage to warm samples up to 700 °C. Three other mobile target chambers can be attached to the rear of the standard target chamber. The first chamber is an Auger analyzer-equipped, ultrahigh-vacuum chamber for implantation in an ultraclean environment and for in situ sputter-Auger analysis of implanted surfaces. The second chamber is equipped with an electron beam evaporator that allows for simultaneous ion bombardment and deposition of thin films (ion-beam-assisted deposition) under computer control. The third chamber is equipped to allow relatively high gas pressures to perform ion-beam-induced chemical vapor deposition of thin films on substrates near room temperature.

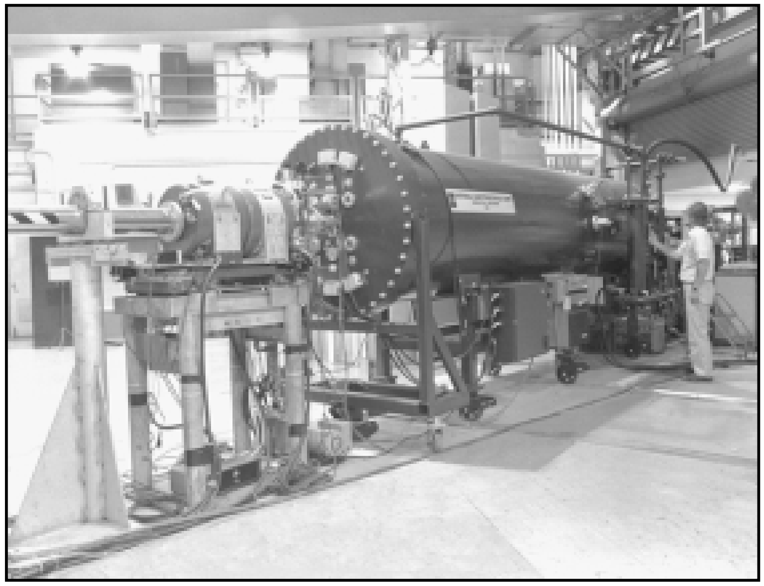
CONTACT:

J. Sprague • Code 6371 • (202) 767-4789

LOCATION:

Bldg. 74, Rm. 212 • NRL, Washington, DC

3-MV Tandem Van de Graaff Accelerator



3-MV Tandem Van de Graaff Accelerator

FUNCTION: Provides a source of high-energy ions for near-surface analysis, high-energy implantation, and radiation effects studies.

INSTRUMENTATION: There are three beam lines: (1) an analysis beam line with a variable angle Si particle detector for Rutherford backscattering and elastic recoil detection, an Si(Li) detector for particle-induced X rays, manual and computer controlled goniometers for ion channeling, NaI and Ge(Li) detectors for gamma ray detection, and a 0.02 steradian acceptance solid angle, double focusing, 180˚ magnetic spectrometer with 0.2% energy resolution; (2) a high-energy ion implantation beam line for uniform implantation over a 4-in. diameter wafer, with heating, and water or liquid nitrogen cooling of the sample; and (3) a small deflection angle beam line for high energy, magnetically rigid heavy ions equipped with a microbeam for spatially resolved studies of radiation effects in devices, with a sampling oscilloscope with 70 GHz bandwidth, and a port for calibration of radiation or particle detectors. All beam lines have cryopumps or turbopumps for clean vacuum conditions.

DESCRIPTION: The 3-MV Tandem Van de Graaff is a model 9SDH-2 Pelletron built by National Electrostatics Corporation. A terminal voltage of 3 MV is generated by 2 "pelletron" charging chains capable of carrying a 300 μA current. Negative ions are injected at 20 to 60 kV and are accelerated to the terminal. Electrons are then stripped from the negative ions by collisions with a stripper gas or carbon stripping foils, and the resultant positive ions are then repelled by the terminal potential to ground. Beam energies attainable depend upon the charge state of the ion and the terminal voltage V, i.e., $E = V(1+i)$, where i is the positive charge on the stripped ion. Thus, protons can be accelerated to 6 MeV, alpha particles to 9 MeV, and highly stripped Au nuclei (+12) to 39 MeV. The lower limit of beam energy is about 400 keV. An RF ion source for gases ionizes hydrogen or helium to produce positive ions and then converts about 2% of them to negative ions by charge exchange in an Rb vapor canal. Beam currents of 12.5 μA for protons and 2 μA for alphas are routine. A cesium ion sputtering source is used to produce negative ion beams of solid elements with beam currents in the nA to 30 μA range.

CONTACT:

G. Hubler • Code 6370 • (202) 767-4786

LOCATION:

Bldg. 74, Rm. 110 • NRL, Washington, DC

Laboratory for the Structure of Matter and Fluid Dynamics

- Parallel High Performance Computer Graphics Facility

Parallel High Performance Computer Graphics Facility

Parallel High Performance Computer Graphics Facility

FUNCTION: The Laboratory for Computational Physics and Fluid Dynamics (LCP&FD) computer systems are available round-the-clock for computational studies in the fields of compressible and incompressible fluid dynamics, reactive flows, fluid-structure interaction (including submarine, ship, and aerospace applications), plasma physics, atmospheric and solar magnetoplasma dynamics, application of parallel processing to large-scale problems such as unstructured grid generation for complex flows, and other disciplines of continuum and quantum computational physics.

INSTRUMENTATION: The computer systems comprise a 64 R12K processor SGI Origin 2000, two parallel processing systems in classified environments, an eight R12K processor Origin, an 18 R10K processor Power Challenge, and a six R8K processor PowerOnyx. The HP Exemplar systems consist of a 64-processor X-Class SPP system and a 16-processor S-Class SPP system. The Alpha cluster is a collection of 21264-processor Linux systems well coupled with Myrinet high-speed switched interconnects. Each system has on the order of 200 GB of disk for storage during a simulation and at least 256 MB of memory per processor.

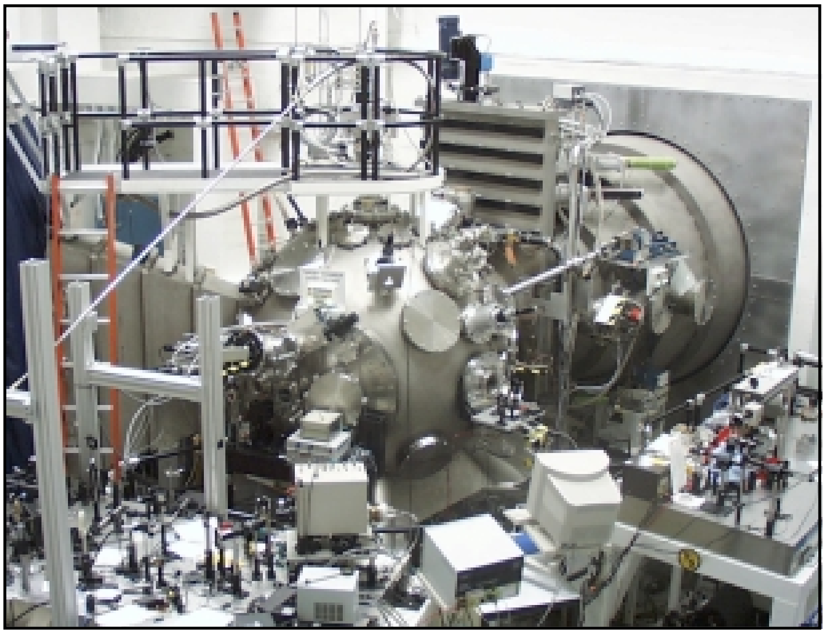
DESCRIPTION: The facility is used to develop and maintain state-of-the-art analytical and computational capabilities in fluid dynamics and related fields of physics, to establish in-house expertise in parallel processing and on-line graphical rendering for large-scale scientific computing, to perform analyses and computational experiments on specific relevant problems, and to transfer this technology to new and ongoing projects through cooperative programs. LCP&FD maintains a very powerful collection of computer systems. There is currently a total of 136 parallel SGI processors, 80 parallel HP processors, 36 clustered Alpha processors, and several other support systems. In addition, there are over 50 Macintosh computers, most of which are capable of large calculations both independently and in parallel ad hoc clusters.

CONTACT:
K. Obenschain • Code 6440 • (202) 404-1063
LOCATION:
Bldg. 97, Rm. 108 • NRL, Washington, DC

Plasma Physics Division

- Nike KrF Laser Facility
- Electra Laser Facility
- Large Area Plasma Processing Systems
- Space Physics Simulation Chamber
- Gamble II
- Hawk
- Long Pulse Accelerator Laboratory
- High-Frequency Microwave Processing of Materials Laboratory
- Pharos Laser System
- T-Cubed Laser System

Nike KrF Laser Facility



Nike Target Chamber

FUNCTION: Study the physics and technology issues of direct-drive laser fusion. Primary areas of research include studies of means to reduce hydrodynamic instability in laser-accelerated targets, studies of the response of materials to extreme pressures, and generation of X rays from laser-heated targets. This work supports the Department of Energy's program for science-based stockpile stewardship.

INSTRUMENTATION: A computer-controlled data acquisition system, high-speed X-ray and optical cameras, high-resolution X-ray imaging systems, X-ray and visible spectrometers, high-speed digital oscilloscopes, and cryogenic target capability.

DESCRIPTION: The Nike laser is a 56-beam krypton fluoride (KrF) system that provides 3 to 4 kJ of laser energy on targets. The laser uses controlled spatial incoherence to achieve highly uniform focal distributions in each of these beams. Up to 44 of the beams are overlapped onto targets with typical focal diameters of 0.75 mm and peak intensities near 10^{14} W/cm^2. The combination of uniform individual beams and smoothing from overlapping numerous beams produces extremely uniform illumination of targets. The effective illumination nonuniformity is less than 0.2% when time averaged over a typical 4-ns laser pulse. Nike thereby produces highly uniform ablation pressures on target that allow well-controlled experiments at pressures up to 20 million atmospheres. The remaining 12 laser beams are used to generate diagnostic X rays that radiograph the primary laser-illuminated targets. The facility includes a front end that generates the desired temporal and spatial laser profiles, two electron-beam pumped KrF amplifiers of 20 and 60 cm aperture, a computer-controlled optical system consisting of approximately 400 mirrors, and a vacuum target chamber for experiments.

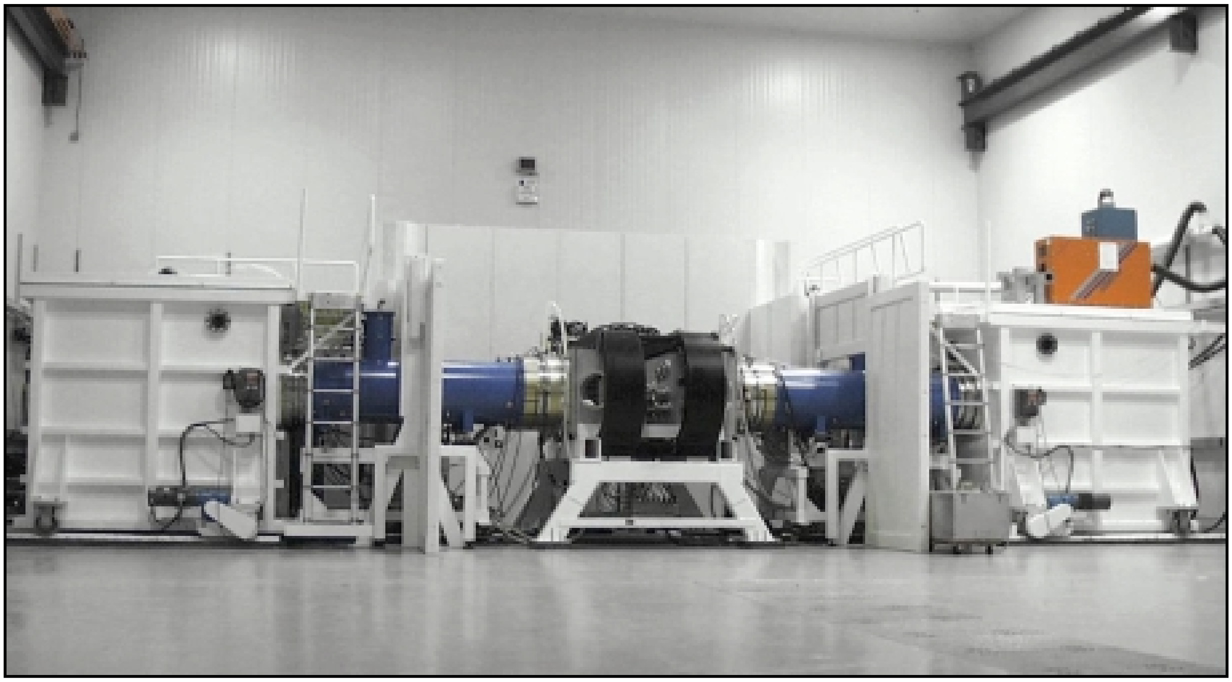
CONTACT:

S. Obenschain • Code 6730 • (202) 767-0689

LOCATION:

Bldg. 71, Nike KrF Laser Bay • NRL, Washington, DC

Electra Laser Facility



Electra Laser Facility

FUNCTION: The Electra Laser Facility will be used to develop the science and technology needed to develop a reliable efficient, high energy, repetitively pulsed krypton fluoride (KrF) laser. It is expected that this facility, when completed, will be able to repetitively generate 700 Joules of laser light in a 100-ns pulse.

INSTRUMENTATION: A computerized control system that continually monitors all system parameters is used to operate the Electra Facility. This includes the input, inter-stage and output voltages, magnet current, trigger laser operation, gas, electrolyte, and coolant temperature and flow. A totally separate system is used to acquire data from the experiment, including electron beam voltage and current, laser gas parameters, laser output, and laser pulse shape.

DESCRIPTION: The Electra main amplifier will be pumped with two 30 cm × 100 cm electron beams, each with $V = 450$ kV, $I = 100$ kA, and $\tau = 100$ ns. Electra will use double-pass laser amplification with double-sided electron beam pumping of the laser gas. This is the same arrangement as in Nike. The laser components that need to be developed are a durable, efficient, and cost-effective pulsed-power system; a durable electron beam emitter; a long-life, high-transmission-pressure foil structure to isolate the laser gas from the electron beam diode; a recirculator to cool and quiet the laser gas between shots; and long-life optical windows. Our plan is to build the laser by sequentially integrating each component as it is developed. As the advanced pulsed power system will take several years to develop, we have built a "First-Generation Pulsed Power System" to start developing the critical laser components right away. This system can run at 5 Hz continuously for 90,000 shots, which is more than ample to start laser component development.

CONTACT:
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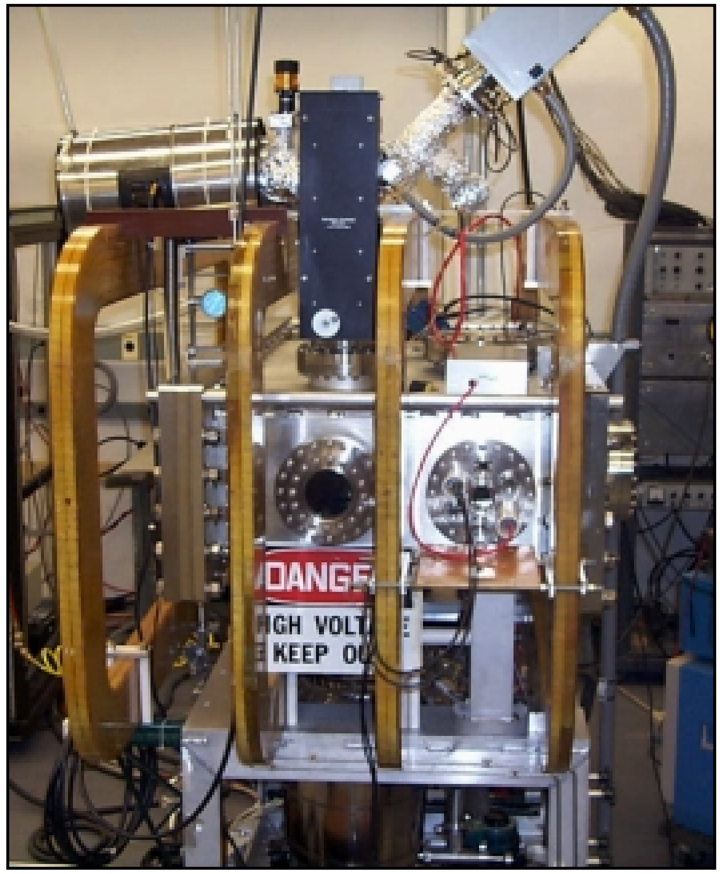
Large Area Plasma Processing System (LAPPS)



Source chamber for
Large Area Plasma Processing System

FUNCTION: Study beam-generated plasmas for materials processing applications. Independently generated kilovolt electron beams pass through the chamber confined by an axial magnetic field and ionize the background gas. The low-temperature, high-density, uniform plasma sheet can be positioned close to a surface to be processed. The NRL-developed Large Area Plasma Processing System (LAPPS) can generate square meter plasmas with higher efficiency and better control than other techniques presently used in materials processing.

INSTRUMENTATION: A variety of plasma and particle collection diagnostics are used. These include Langmuir probes to measure plasma density, plasma potential, and temperature; biased charge collectors to measure local ion densities and plasma potential; a combination particle energy analyzer and quadrupole mass analyzer to identify particles and determine their energy; optical diagnostics to measure plasma temperature and composition; and a laser-induced fluorescence system that is due to come on line in 2001 for measuring local particle energies. A large number of ports were built into the chamber to facilitate diagnostics.

DESCRIPTION: The ultrahigh vacuum chamber shown is filled with a process gas. The large field coils are used to generate 100 to 300 Gauss magnetic fields along one axis, which confine a 1 to 3 kV, few milliamperes per square centimeter electron beam. A surface located inside the chamber can be moved close to the plasma sheet generated by the beam. Materials such as semiconductors to be etched or dielectrics to be coated can be mounted on the surface for processing by the plasma. The ports are used for diagnostics to measure beam, plasma, or surface conditions.

CONTACT:
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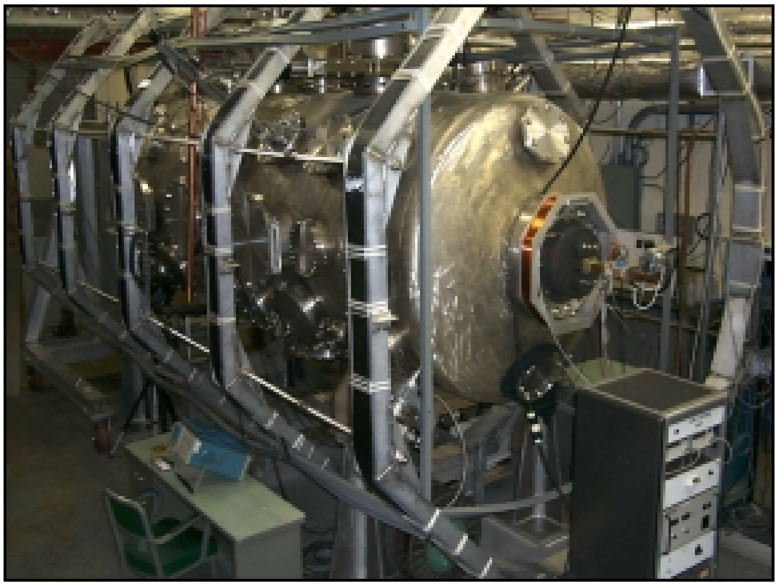
Space Physics Simulation Chamber (SPSC)



Space Physics Simulation Chamber

FUNCTION: Simulates near-Earth space environment under controlled, reproducible conditions. The Space Physics Simulation Chamber (SPSC) is used to study ionospheric, magnetospheric, or solar wind plasma phenomena, testing/ calibration of space-qualified diagnostic instruments to be launched on orbital or suborbital missions, spacecraft charging, large-volume plasma generation, and other topics requiring a low-pressure environment.

INSTRUMENTATION: A full range of plasma diagnostics are available, including internally heated Langmuir probes, emissive probes, ion energy analyzers, ac magnetic field probes, and pressure probes. Numerous transient recorders, power supplies, digital multimeters, electrometers, and amplifiers are available. The instrumentation is GPIB-controlled using Labview software.

DESCRIPTION: The SPSC is a 1.8-m diameter, 5-m long stainless-steel vacuum vessel containing numerous access ports. Dual cryogenic vacuum pumps maintain SPSC base pressure near 10^{-6} torr. Five magnetic field coils provide a uniform dc axial magnetic field up to 50 G or pulsed fields up to 1 kG. Bucking coils are also available for cancellation of Earth's magnetic field. The SPSC is equipped with two large-volume plasma sources (plasma column diameter ~0.5 m): (i) a microwave discharge plasma source (plasma densities ranging from 10^5-10^9 cm^{-3} and electron temperatures of ~0.5 eV) and (ii) a large-area thermionic discharge plasma source (plasma densities ranging from 10^5-10^{12} cm^{-3} and electron temperatures ranging from 0.1-2 eV). Access for electrical, diagnostic, and manipulator vacuum penetration is available over most of the SPSC volume. The SPSC is also equipped with an internal 3D positioning system capable of probing nearly the entire volume of the plasma column.

CONTACT:

W. Amatucci • Code 6755 • (202) 404-1022

LOCATION:

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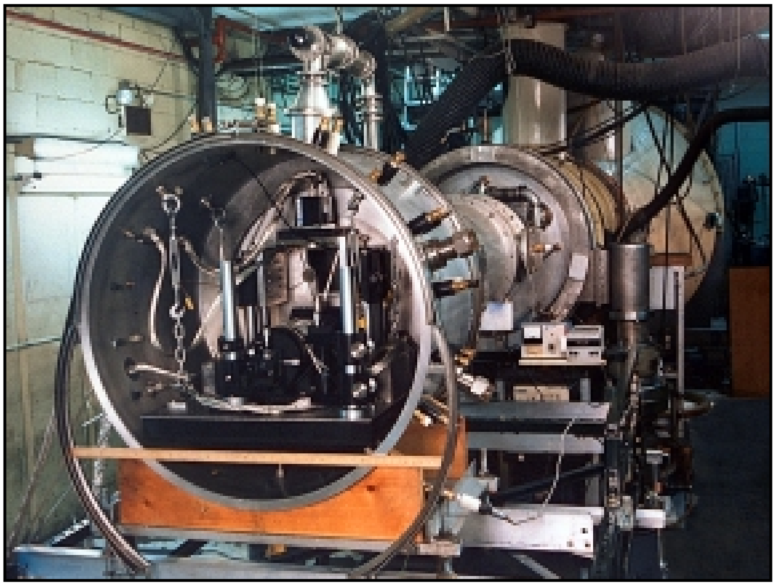
Gamble II



Gamble II

FUNCTION: Produces high-voltage (3 MV), high-current (> 1 MA), short (< 100 ns) pulses of energy of either positive or negative polarity. These terawatt power level pulses are used for many Navy, DoD, and DoE programs including nuclear weapons effects simulation, ion beam production studies for inertial confinement fusion, particle beam production and focusing for directed-energy weapons, and dense Z-pinch production for X-ray laser research. The device also serves as a test bed for advanced pulsed power research on opening switches.

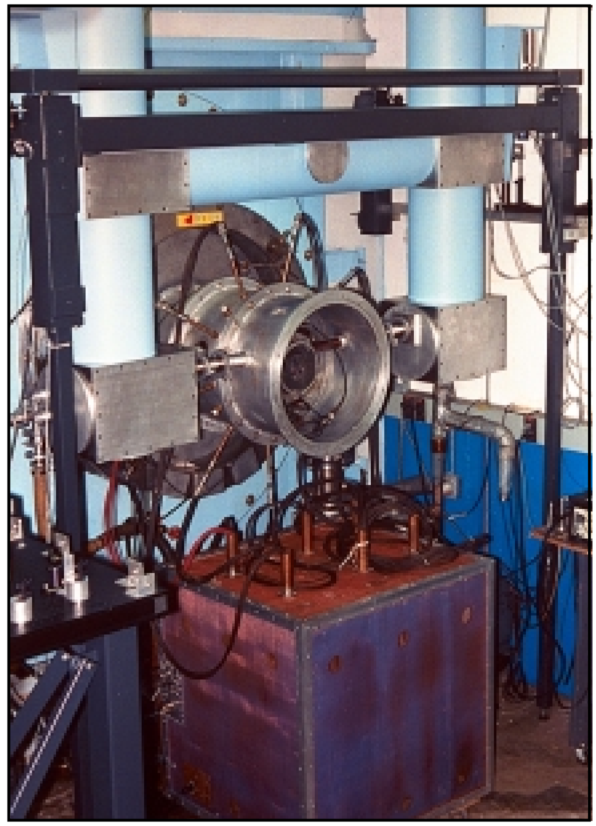
INSTRUMENTATION: Diagnostics for the generator and the beams are monitored in a shielded room located outside the radiation area. Diagnostics include sophisticated computer-controlled transient recorders or oscilloscopes to record analog signals, numerous optical, X-ray, or neutron diagnostics, and nuclear activation monitors.

DESCRIPTION: The facility's 300-kJ Marx generator is a large capacitor bank capable of producing several megavolt voltages. The voltage pulse is then compressed in time duration through a succession of water dielectric pulse-forming lines separated by closing switches to eventually arrive as a high-power pulse across a vacuum diode. This pulse can be applied directly across a load (such as a gas column or wire) or can be used to produce powerful electron or ion beams. These high-power beams are then allowed to interact with X-ray converters or to propagate to a variety of targets. The facility is surrounded by thick concrete shielding to contain X rays produced as a result of the high-power pulses.

CONTACT:
B. Weber • Code 6770 • (202) 767-8373
LOCATION:
Bldg. 71, Rm. 1102 • NRL, Washington, DC

Hawk

Hawk



FUNCTION: Produces a high-current (750 kA) pulse with a microsecond rise time into a vacuum inductor. The energy stored in the inductor is transferred to a radiation or particle-beam load by using a plasma opening switch (POS). These inductive energy store (IES) generators represent a new approach for generating high-power pulses for Navy, DoD, and DoE applications, including nuclear weapons effects simulation, inertial confinement fusion, and dense Z-pinch X-ray sources. The device is used primarily as a research test bed for IES technology and for fundamental research into the physics of POS operation.

INSTRUMENTATION: Diagnostics for the generator and POS are monitored in a shielded room located outside the radiation area. Diagnostics include sophisticated computer-controlled transient recorders to record analog signals, various optical, X-ray, and nuclear activation monitors, and plasma diagnostics such as interferometers and charged particle detectors for measuring quantities of interest in the POS.

DESCRIPTION: The facility consists of four Marx banks in an oil-filled tank, connected in parallel, with an output voltage of 720 kV when the capacitors are charged to 90 kV each. The Marx bank stores 300 kJ of electrical energy. The discharge of the capacitors into the system inductance (700 nH) results in a sinusoidal current with a 1.2-µs quarter period and an amplitude of 750 kA. A POS is used to conduct the generator current during most of this rise time (typically for about 1 µs) while the energy is transferred from the capacitors to the circuit inductance. The POS then opens quickly (in less than 100 ns) allowing the current to flow to a downstream load, for example, an electron-beam diode. The facility is surrounded by thick concrete shielding to contain X rays produced as a result of the high-power pulses.

CONTACT:
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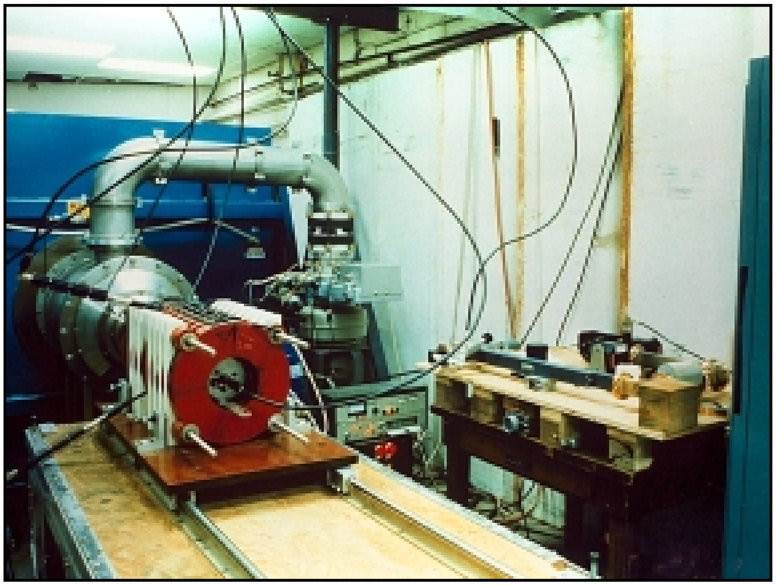
LOCATION:
Bldg. 71, Rm. 1117 • NRL, Washington, DC

Long Pulse Accelerator Laboratory



1-MV Long Pulse Accelerator Laboratory

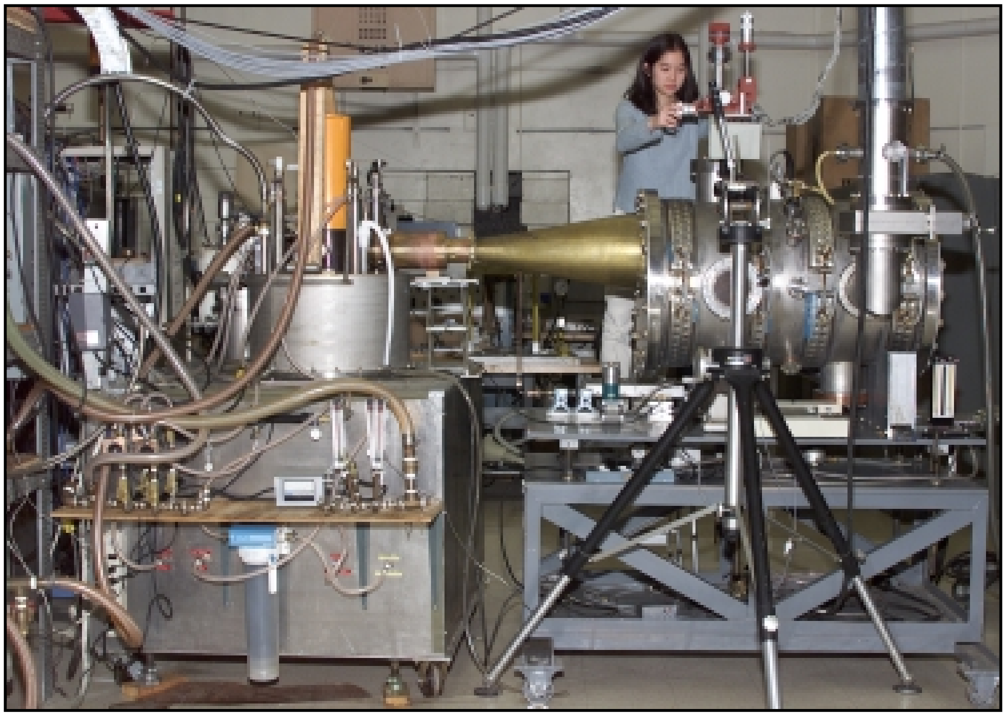
FUNCTION: Explores the production of high-power microwave and millimeter-wave radiation from coherent sources driven by intense relativistic electron beams produced by a Marx generator. Issues include maximizing amplifier gain, optimizing power and efficiency, and mode stability in scanning beam and gyroresonant microwave devices.

INSTRUMENTATION: The instrumentation includes ten 500 MHz digitizing oscilloscope channels, a computer to acquire the digitized data, a large number of 250 MHz analog oscilloscope channels, and a variety of microwave and electron beam diagnostic equipment. Ancillary equipment includes three capacitor banks to fire magnetic field coils, high-voltage power supplies, a microwave calibration facility, and a variety of microwave sources ranging from 3 to 35 GHz.

DESCRIPTION: The accelerator is a Marx generator with variable shunt and crowbar, with voltage adjustable from 250 kV to 1 MV in 1% steps, and pulse length adjustable up to 1 μs for voltages of 500 kV to 1 MV, and up to 10 μs for 250 to 500 kV. The voltage flatness is ±1% ripple, 2% droop for a 1 μs pulse into a 1000-ohm load.

CONTACT:
S. Gold • Code 6793 • (202) 767-4004
LOCATION:
Bldg. 101, Rms. 108 to 112 • NRL, Washington, DC

High-Frequency Microwave Processing of Materials Laboratory



High-Frequency Microwave Processing of Materials Laboratory

FUNCTION: Develops and operates a high-power continuous-wave (CW) 83 GHz beam for rapid, selective millimeter-wave processing of ceramics and metals. Processes under investigation include: high-strength joining of ceramics to ceramics and to metals; application of ceramic coatings on ceramic and metal substrates; and production of nano-crystalline metal powders.

INSTRUMENTATION: The Gycom, Ltd. 15-kW gyrotron and associated DC power supply and superconducting 3 T magnet are controlled and monitored by a computer-based operating system programmed in LabView. Several workpiece temperature diagnostics are available including a two-color IR pyrometer (range: 800° to 2000 °C).

DESCRIPTION: A free-space propagating, quasioptical beam of intense polarized millimeter-wave radiation is produced by an 83 GHz, 15-kW CW industrial gyrotron and injected into a stainless steel processing chamber (1 m long × 0.65 m diameter) where it is focused onto the workpiece. Beam intensities up to 0.1 megawatt per square centimeter can be achieved, the beam power is variable up to 15 kW, and the pulse length is variable from 1 second to continuous wave operation. Minimum spot size (0.5 cm), area illumination (20 × 20 cm), and strip illumination (0.5 × 20 cm) of the workpiece can be achieved using focusing mirrors. Various processing atmospheres can be used and workpieces can be heated rapidly to temperatures exceeding 2000 °C.

CONTACT:
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LOCATION:
Bldg. 256, Rm. 4 • NRL, Washington, DC

Pharos Laser System

Pharos Laser System

FUNCTION: Conducts high-power, short pulse, laser-plasma, and laser-solid interaction studies that include nuclear blast effects simulation, shock wave generation, and interaction in solids and plasmas, and shock wave and explosive cavitation interaction in water and water-saturated seabed sands.

INSTRUMENTATION: A large variety of laser plasma diagnostics are available. These include time-integrated visible and X-ray spectrographs and beam diagnostics as well as high-speed drum cameras, ultra-high-speed gated optical imagers, streak cameras, and single-channel detectors sensitive to both visible and X-ray wavelengths. Several specially designed lower power lasers are also available as probes for optical diagnostics.

DESCRIPTION: The facility consists of the Pharos laser with associated target chambers and dedicated diagnostics. Pharos is a Nd:Glass laser that provides two 15-cm clear aperture beams of 1-micron wavelength light. Each beam can deliver more than 500 J of energy on target in a 5-ns pulse. The system repetition rate at full energy is once every 50 minutes. Each of the beams may be independently targeted and independently timed. Harmonic generation crystals can be used to convert the laser's output from 1.0 to 0.5 micron wavelength. The system has recently been relocated to a new, improved laboratory space.

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T-Cubed Laser System

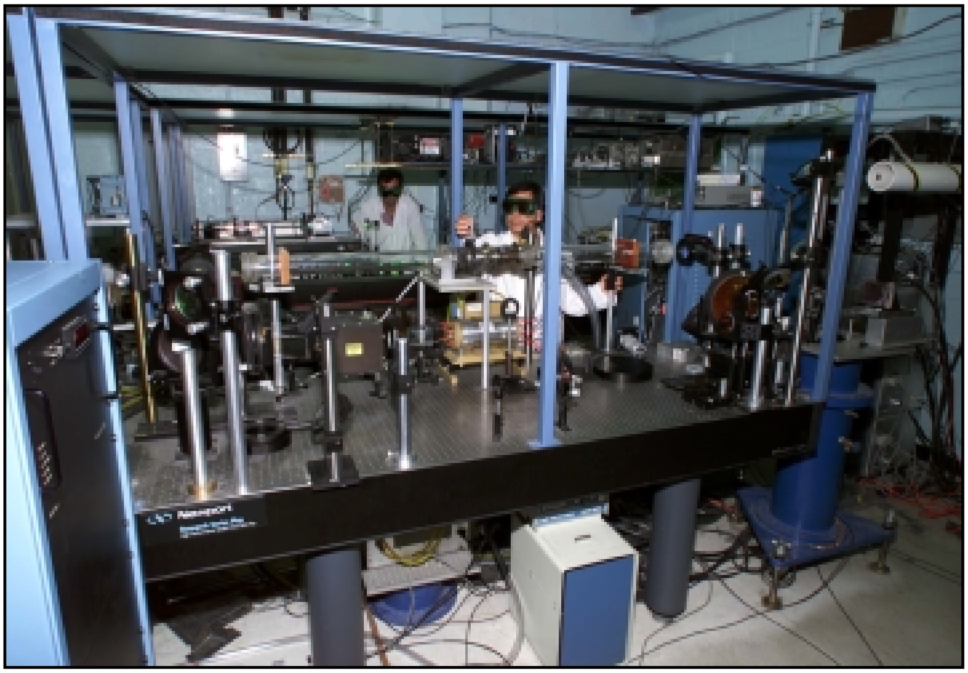

Table-Top Terawatt Laser

FUNCTION: Conducts ultrahigh-power, ultrahigh-intensity laser-plasma, laser-electron beam, and laser-solid interaction studies that include fundamental strong-field physics experiments, and new imaging and diagnostic techniques.

INSTRUMENTATION: A large variety of laser plasma and electron beam diagnostics are available. These include laser diagnostics, auto-correlators, FROG (frequency resolved optical gating), interferometers, optical and X-ray spectrometers, optical and X-ray streak cameras, gated optical imagers, infrared linear and two-dimensional sensor arrays, X-ray diodes, and magnetic electron spectrometers. Several lower power lasers are also available as probes for optical diagnostics.

DESCRIPTION: The facility consists of the T-Cubed (Table-Top-Terawatt) laser with associated target chambers and diagnostics. The T-Cubed laser system uses chirped pulse amplification of 1.053 μm wavelength light. It can provide >8 Joules of energy in a 400 femtosecond pulse using a vacuum optical compression chamber, thus providing pulsed power greater than 20 TW. The excellent beam quality of the amplified light provides focused intensities ~10^{19} W/cm^2 on target. The laser pulse also has high contrast ratio so that plasma formation due to prepulse illumination of the target can be minimized. The system repetition rate at full energy is once per 20 minutes without degrading the beam quality. Optical compression in air can deliver 1 J energy pulses at a rate of once per 5 minutes. Frequency-doubled pulses at 527 nm wavelength can be obtained at ~70% efficiencies. A 10 Hz high repetition rate T-Cubed laser system at 800 nm wavelength is being developed.

CONTACT:
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Bldg. 101, Rm. 142 • NRL, Washington, DC

Electronics Science and Technology Division

- Nanoelectronics Processing Facility
- Ultrafast Laser Facility
- Space Solar Cell Characterization Laboratory
- Vacuum Electronics Fabrication Facility
- Compound Semiconductor Processing Facility
- The MOCVD Laboratory
- Epicenter for Advanced Materials Growth and Characterization

Nanoelectronics Processing Facility (NPF)

Electron beam nanowriter in use defining geometries as small as 50 Å (approximately 10 atomic layer spacings)

FUNCTION: Develops and provides nanofabrication processing, design, and characterization for a wide range of both electronic and nonelectronic materials and devices. The NPF's capabilities are available to a broad range of customers (both at and outside of NRL).

INSTRUMENTATION: The NPF maintains a tool base of state-of-the-art processing equipment. A strong emphasis is on computer-aided design and lithography using two e-beam systems, each with a 10-nm spot size. Conventional deep ultraviolet optical lithography, reactive ion etching, ultraclean oxidation furnaces, polysilicon deposition furnaces, metal evaporation, ion milling, scanning electron microscope evaluation, and a complete bonding, sawing, packaging, and electrical characterization capability are also available.

DESCRIPTION: The NPF's equipment base and operation is designed around state-of-the-art capability and flexibility targeted at prototyping a small number of samples. Sample sizes from 4-in. (100-mm) wafers to 1-cm square pieces can be processed. The NPF has provided prototypes and concept demonstration in numerous electronic and nonelectronic projects including charge-coupled device radiation sensors, metal-semiconductor-metal photodetectors, ionizing radiation detectors, tactile sensors, high electron mobility transistors, quantum effect devices, elements for diffractive optics, diamond field emission arrays, X-ray masks, infrared etalons, magnetic memory devices, silicon carbide oxide growth, and molecular large area printing. The NPF has been responsible for several advances in nanofabrication processing such as 15-nm lithography on high atomic number substrates, anisotropic plasma etching in silicon and tungsten, and the control of proximity effects with thin dielectric layers.

CONTACT:
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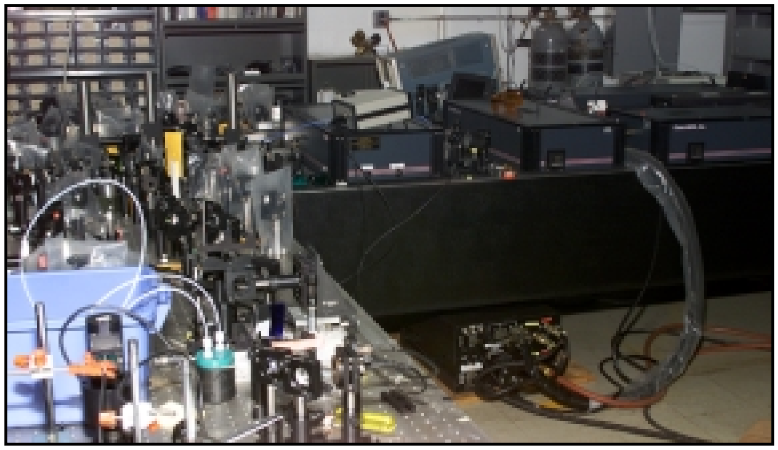
LOCATION:
Bldg. A-69, all rooms • NRL, Washington, DC

Ultrafast Laser Facility (ULF)



The amplified titanium sapphire system for investigating ultrafast processes in condensed matter systems

FUNCTION: Supports a broad range of basic and applied research that include understanding primary photophysical processes in molecules and supermolecular systems, characterizing the nonlinear optical response of nanoscale materials, and simulating the effects of space radiation with state-of-the-art microelectronics circuitry. The ULF supports NRL 6.1 research programs and collaborative research projects with outside university and government institutions. Customers from the space electronics industry use the ULF as a tool to optimize circuit designs for space applications.

INSTRUMENTATION: The ULF contains laser systems capable of producing laser pulses in a temporal range between 20 femtoseconds and 100 picoseconds. The core femtosecond system consists of an amplified titanium sapphire laser that is coupled to an optical parametric amplifier. This system generates tunable femtosecond pulses from the mid-infrared to the ultraviolet portions of the spectrum. A second femtosecond titanium sapphire oscillator is available for applications requiring high pulse repetition rates. The ULF also maintains a synchronously pumped cavity-dumped dye laser system, which produces picosecond pulses in the visible and near infrared. A time-correlated photon counting apparatus provides a sensitive measurement of fluorescence signals. The ULF has the optical apparatus and spectroscopic instrumentation to perform a wide variety of ultrafast and nonlinear optical experiments.

DESCRIPTION: The ULF's equipment has recently been used to perform experiments that measure ultrafast photophysical processes in organic macromolecules, dendrimers, and in nanoscale organic/inorganic hybrid materials. An optical apparatus has been configured to characterize photophysical mechanisms using transient pump-probe spectroscopy at either a single frequency, or using a multicolor continuum probe. A separate apparatus is dedicated to characterizing the magnitude and temporal response of the nonlinear optical susceptibility of semiconductor nanoparticles, and novel polymer-based materials. The ULF also supports research in "coherent control," where the phase and amplitude properties of the laser field are used to control the light-matter interaction. The ULF is also devoted to understanding the effects of space radiation on microelectronics circuitry. Picosecond laser pulses are used to simulate the interaction of space radiation with semiconductor material (Si, GaAs, InAs, etc.). The picosecond pulsed laser permits the study of space-radiation effects in microelectronics in a highly controlled manner, and, thus, complements experiments performed at accelerator facilities. The ULF has proven invaluable to the space industry for troubleshooting microelectronic circuits for space applications.

CONTACT:
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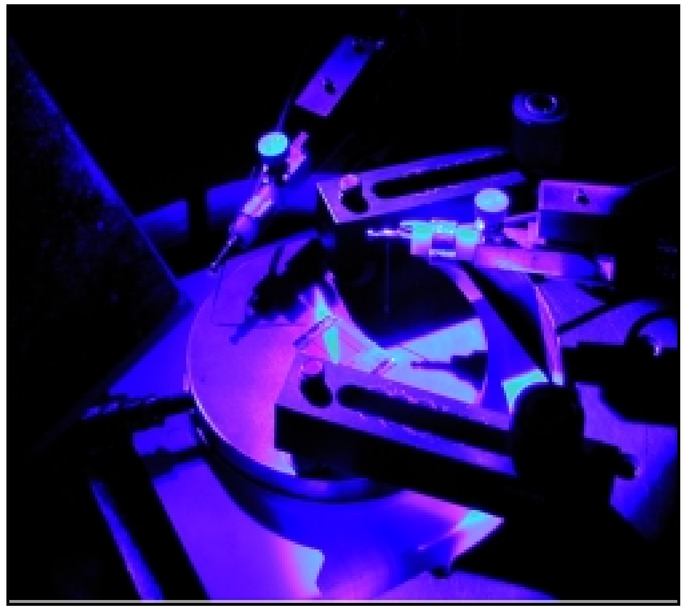
Space Solar Cell Characterization Laboratory



Silicon solar cell under colored light bias mounted in the NRL spectral response measurement system

FUNCTION: Measures, characterizes, and analyzes photovoltaic materials and devices. The primary focus is the measurement and characterization of solar cell response to exposure to natural and man-made radiation environments. These facilities are used by a range of customers, both commercial and government, for performing experiments ranging from in-depth basic studies of radiation response mechanisms to large-scale product qualification campaigns.

DESCRIPTION: The solar cell laboratory facility is unique in its combination of measurement, analysis, and modeling capabilities. The laboratory contains the in-house expertise to assess a photovoltaic technology, design and implement the most effective characterization test plan, and analyze the results to produce an in-depth materials characterization and device performance evaluation. Furthermore, using the displacement damage dose analysis technique developed within the laboratory, the experimental results can be rapidly translated into accurate predictions of device performance in essentially any radiation environment, particularly that of Earth orbit.

MEASUREMENT CAPABILITIES: The solar cell laboratory boasts a wide array of measurement capabilities. The central features are a Spectrolab X-25 Mark II solar simulator providing one sun, air-mass zero (AM0) illumination with 2% uniformity over 78 in^2, with 2% spectral fidelity from 300 to 1600 nm, and a custom-built spectral response system ranging in wavelength from 340 to 2400 nm with specialized light and electrical biasing schemes allowing individual subjunction measurements in multijunction devices to be performed. The laboratory also contains diode dark-current measurement systems, a deep level transient spectrometer, an electrochemical capacitance-voltage profiler, and a state-of-the-art Hall Effect system. Electron-beam-induced current and cathodoluminescence capabilities will be available by second quarter FY01.

RADIATION FACILITIES: NRL maintains in-house radiation facilities and has long-standing relationships with facilities at many other government laboratories, providing access to virtually any desired radiation test environment. Focusing on the natural space radiation environment, NRL has established specialized test chambers enabling exposure of multiple, large-area solar cells to electron and proton irradiation over a wide range of particle energies and fluxes.

CONTACT:
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LOCATION:
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Vacuum Electronics Fabrication Facility (VEFF)

High-purity vacuum/hydrogen/nitrogen furnace for brazing, heat treating, and ceramic metallizing operations in the 600 to 1700 °C temperature range

FUNCTION: Provides electrical and mechanical design, fabrication, assembly, modification, and repair, as well as processing services for vacuum electronic devices. The VEFF also maintains support equipment primarily for the Tri-Service vacuum electronics research and development programs conducted at NRL as the lead laboratory.

INSTRUMENTATION: The VEFF operates and maintains a high vacuum laboratory and processing facilities that encompass furnace, chemical, computer-aided design, high vacuum processing, precision assembly, and precision machining facilities, all of which are fully equipped with state-of-the-art processing equipment.

DESCRIPTION: VEFF staff collaborates with principal investigators, obtaining theoretical design data and initiating the experimental device production process. VEFF engineers then produce assembly and detail parts drawing packages and coordinate a broad spectrum of shop activities to produce unique vacuum electronic components. In-house preparation of these specialized components includes heat treatment, surface preparation, and microcleaning, vacuum firing, brazing, and extensive quality assessment. Leak-tight joining of high-purity alloys and refractory metals and ceramics is accomplished using brazing, welding, diffusion bonding, and other specialized processes. Specialized fixtures and jigs are fabricated where required. Completed experimental assemblies are evacuated, baked out, and delivered to the investigator's lab, ready for experimentation. Since 1980, the VEFF staff has been called on to provide expertise and equipment to repair, overhaul, or modify various experimental or commercially produced microwave or millimeter-vacuum electronic devices.

CONTACT:
J. Calame • Code 6843 • (202) 404-2799
LOCATION:
Bldg. 208, Rms. 219A, 226A, and 341A • NRL, Washington, DC

Compound Semiconductor Processing Facility

Compound Semiconductor Processing Facility

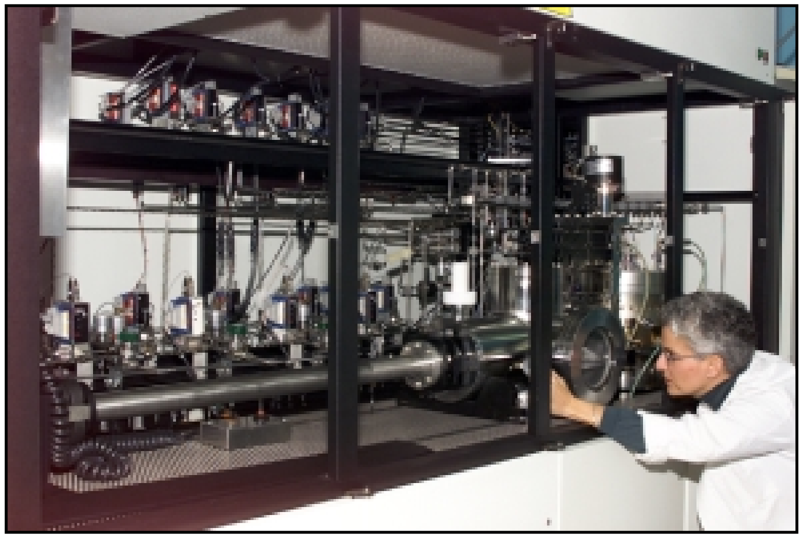
FUNCTION: Provides a research environment for hands-on fabrication of novel structures for fundamental investigations of new compound semiconductor materials, devices, and circuit concepts. Also provides a service facility for fabrication of devices and circuits on compound semiconductors.

INSTRUMENTATION: Principal capabilities include (1) standard photolithography—photoresist spinner and bake ovens, microscope, mask aligner operating in the 300-nm UV range, DUV flood exposure system; (2) metallization—e-beam evaporation for standard metals and RF sputtering for refractory metals; (3) dry etching—reactive ion etching (RIE) and plasma etching; (4) silicon nitride deposition—plasma enhanced chemical vapor deposition; (5) other—contact alloying, profilometer, rapid-thermal-annealing (RTA), annealing furnaces, and gold plating.

DESCRIPTION: The facility consists of a 1500-ft^2 clean room area (Class 10,000) with HEPA filtration, temperature/humidity control, and an independent air handling system with single-pass capability. A full-time technician is assigned to the facility for maintaining the equipment, ordering supplies, training new users, and assisting the hands-on users on specialized runs. State-of-the-art microwave and optoelectronic devices are processed in the facility using gallium arsenide, gallium nitride, and indium phosphide material systems.

CONTACT:
D. Webb • Code 6850 • (202) 767-3312
LOCATION:
Bldg. 208, Rms. 503 and 504 • NRL, Washington, DC

The MOCVD Laboratory



A MOCVD reactor in the MOCVD Laboratory

FUNCTION: NRL's primary site for the exploration of crystal growth via metalorganic chemical vapor deposition (MOCVD). Current research activities include the growth of wide bandgap semiconductor materials and device structures for use in power electronics, RF communications, and radar. The materials used in this activity are gallium nitride and alloys within the GaN materials system such as AlGaN. Research activities range from basic research studies of materials and crystal growth to more applied investigations involving devices.

INSTRUMENTATION: The facility houses two state-of-the-art reactors for growth of GaN and its technologically important ternary compounds. Computer control of gas sequencing and delivery is being installed on one of these reactors. The remaining two reactors are reserved for gallium arsenide or indium phosphide growth and for growth of the technologically important ternary compounds of gallium arsenide. The laboratory has an integral safety system including gas detectors and alarms.

DESCRIPTION: The organometallic vapor phase epitaxy growth of homoepitaxial or heteroepitaxial films of GaN and AlGaN is performed on lattice matched and mismatched substrates such as platelets of bulk GaN, 6H-SiC, or sapphire. The growth is accomplished by the reaction of organometallic precursors that typically contain the column III metal, e.g., $Ga(CH_3)_3$ or $Al(CH_3)_3$, and the organometallic or hydride precursor of the column V element, e.g., NH_3. Depending on the semiconductor being grown, the reactions take place at pressures 5% to 50% of ambient over a substrate heated in the range of 500° to 1100 °C. Growth rates are typically determined by the column III precursor flux, which is controlled by the temperature and pressure of the sources and the mass flow rate of the high purity carrier gas flowing through the source, and range from 0.2 Å/s to 10 Å/s. The crystal quality is a direct function of growth parameters such as the pressure used for deposition. The epilayers can be doped n- or p-type with dopants such as Si or Mg. Through knowledge and control of the growth process, different types of structures containing complex heterojunctions can be grown. The equipment is housed in a specially designed and constructed building for the chemicals used in the growth process.

CONTACT:
R. Henry • Code 6860 • (202) 767-3671

LOCATION:
Bldg. A-11, all rooms • NRL, Washington, DC

Epicenter for Advanced Materials Growth and Characterization

The Epicenter

FUNCTION: Fabricates and analyzes heterostructures that are used in ongoing electronic and optoelectronic device efforts.

INSTRUMENTATION: This facility includes five interconnected ultrahigh vacuum systems for molecular beam epitaxy film growth and film analysis. Three of these chambers are used for molecular beam epitaxial growth of III-V semiconductors, II-VI semiconductors, and ferromagnetic semiconductors. Film analysis is accomplished with an angle-resolved electron spectrometer and a scanning tunneling microscope housed in the two other systems. These techniques provide information about the elemental composition, bonding configurations, and morphology of the film surfaces.

DESCRIPTION: Advances in molecular beam epitaxy allow the Epicenter to address the control of the structure of solids on the monolayer-length scale. This flexibility in the fabrication of semiconductors allows quantum mechanical control of electronic wave functions, which allows the electronic and optical properties of semiconductors to be engineered for particular device applications. Heterostructures formed from III-V semiconductors with 6.1Å lattice spacing (GaSb, AlSb, InAs, and related alloys) are grown in the Epicenter. These heterostructures have the potential to define a new state-of-the-art in applications that include >100 GHz high-speed logic circuits, terahertz transistors, sensitive infrared detectors, and mid-infrared semiconductor lasers. III-Mn-V ferromagnetic semiconductors and ZnMnSe, ZnCoSe, and ZnFeSe dilute magnetic semiconductors are also fabricated in the Epicenter. The development of these materials should allow the creation of a new class of devices with operating principles that rely on the spin of the electron, commonly referred to as "spintronics."

CONTACT:
B. Shanabrook • Code 6870 • (202) 767-3693
LOCATION:
Bldg. 208, Rms. 103A to 111A • NRL, Washington, DC

Center for Biomolecular Science and Engineering

- Advanced Microscopy Facility
- Liquid Crystal Fabrication Facility

Advanced Microscopy Facility

Advanced Microscopy Facility

FUNCTION: Provides a facility for high-resolution studies of complex biomolecular systems. The goal is an understanding of how to engineer biomolecules for various applications, including sensors, self-assembled lipid microstructures, patterned surfaces, and biomaterials.

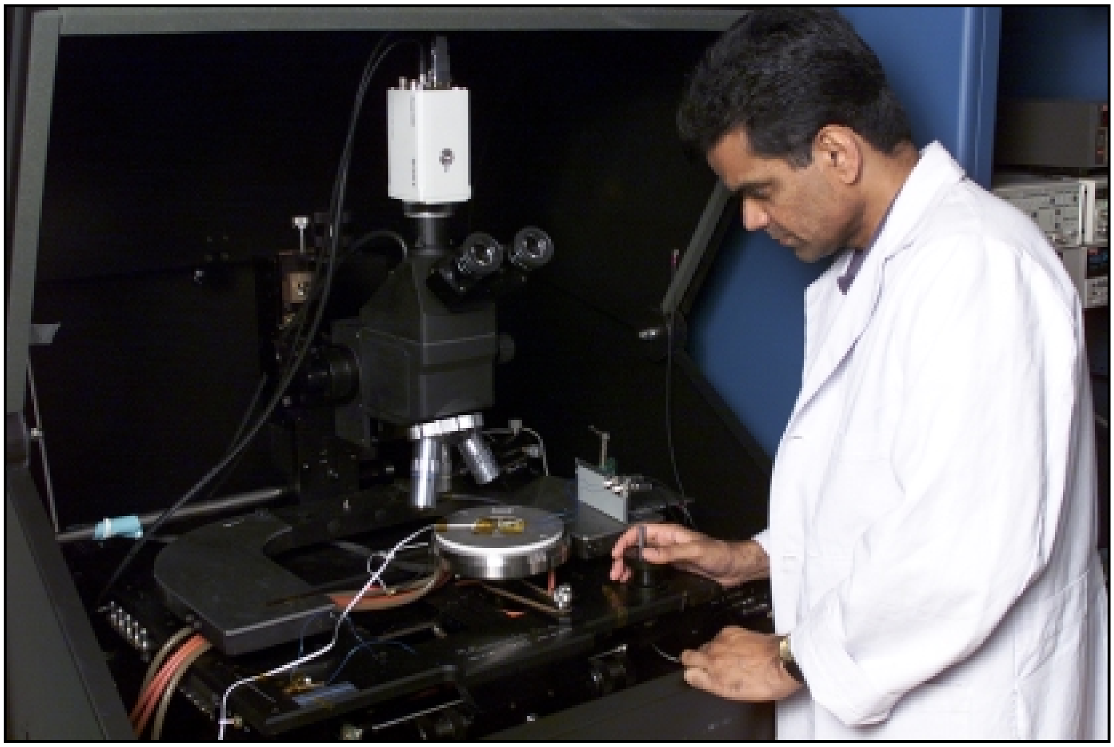
DESCRIPTION: The facility includes electron microscopes, a darkroom, and adjacent biochemical laboratories for sample preparation and additional chemical/physical characterization of proteins, lipids, DNA, and cells.

INSTRUMENTATION:

- Digital scanning electron microscope - Leo 1455
- Hitachi H8100 AEM
- Zeiss transmission electron microscope (TEM) - EM10
- Scanning probe microscope - Topometric Explorer AFM
- Digital Instruments AFM - Dimension 3100
- Scanning probe microscope capable of Multimode Atomic Force
- Microscopy and scanning tunneling microscopy (STM)
- Scanning-tip AFM capable of imaging large samples using contact mode, noncontact mode, lateral force mode, and force modulation mode
- TopoMetrix Aurora Near-field Scanning Optical Microscope (NSOM)
- Optical equipment
- Confocal fluorescent microscope
- CW fluorimeter and microscope
- Optical and fluorescence microscopes
- Freeze fracture apparatus - BALZERS BAF-400
- High-speed ultracentrifuges.

CONTACT:
R. Price • Code 6930 • (202) 404-6018
LOCATION:
Bldg. 30, Rm. B6 • NRL, Washington, DC

Liquid Crystal Fabrication Facility



Liquid Crystal Fabrication Facility

FUNCTION: Provides facilities to synthesize and characterize liquid crystals for basic and applied research.

DESCRIPTION: This laboratory is equipped with capabilities required for synthesis of complex liquid crystals. Initial characterization of synthesized materials is performed using standard techniques such as IR, NMR, TLC, HPLC, and UV-VIS spectroscopy. Materials are further characterized in thin liquid crystal cells (2 microns to 150 microns) or as free-standing films with a view to develop structure property relationships. Applications of these materials include pyroelectric and acoustic detectors, displays, and artificial muscle materials.

CONTACT:
R. Shashidhar • Code 6950 • (202) 404-6005
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Bldg. 30, Rm. 202 • NRL, Washington, DC

OCEAN

AND ATMOSPHERIC SCIENCE AND TECHNOLOGY DIRECTORATE

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Acoustics Division

- Acoustic Communications Measurement System
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- Multichannel Acoustic Data Processing Laboratory
- Autonomous Acoustic Receiver System
- Salt Water Tank Facility
- Tactical Oceanography Simulation Laboratory and Wide Area Network
- Shallow-Water High-Frequency Measurement Systems

Acoustic Communications Measurement System (ACOMMS)

200 dB source transducer and V-fin towbody

FUNCTION: Designs and develops adaptive signal processing techniques to improve underwater acoustic communications. Specific signal patterns are transmitted from NRL's acoustic projector source through the underwater medium to NRL's receiver array. Received signals are processed using a joint adaptive decision feedback equalizer and phase-locked loop algorithm. Improved signal processing techniques are developed and refined to minimize the bit error rate and to evaluate environmental influences on the processor's performance.

INSTRUMENTATION: Source components include: CD player, power amplifier, step-up transformer, transducer, and towbody. Receiver components include: custom designed 16-channel hydrophone array, signal processing electronics, and data monitoring and recording equipment.

DESCRIPTION: Presently, acoustic communications research is conducted at mid frequencies (<10 kHz) and high frequencies (>10 kHz). Source signal patterns designed by NRL are burned onto CD-ROMs and played on a commercial CD player. A power amplifier increases the drive up to 2,000 W and is coupled to the projector via a custom-designed matching transformer. Special cables connect shipboard drive electronics to the projector, which is mounted in a towbody that trails below and behind the ship. Source levels as high as 200 dB re 1 µPa are transmitted through the underwater medium and received at a custom-designed hydrophone array. Relative position, speed, and depth of the projector and receiver array are carefully controlled throughout the experiments. The receiver system is based on a linear array of 16 elements vertically suspended in the water column. Shipboard electronics amplify the weak hydrophone signals and condition them for digitization and recording. Custom-designed software is used for onboard data monitoring and signal processing. In the laboratory, advanced signal processing algorithms are applied to the recorded signals to extract the phase-encoded bit patterns and to improve communication accuracy.

CONTACT:
M. McCord • Code 7120 • (202) 767-2945
LOCATION:
Bldg. 2, Rm. 156 • NRL, Washington, DC

Instrumentation Suite for Making Measurements of Acoustic Propagation in Complex Shallow Water Environments

RF-telemetered receiving array (left) and an autonomous sound source (right) being deployed in the ocean

FUNCTION: Obtain at-sea measurements to test theoretical and modeling predictions of acoustic propagation in dynamic, inhomogeneous, and isotropic shallow-water environments. The theories and models predict variations of signal amplitude, coherence, and travel time due to interaction of sound with small to large-scale volume inhomogeneities within the water column and ocean sediment. The instrumentation suite provides calibrated measurements of these quantities in the frequency range 50 Hz to 20 kHz.

INSTRUMENTATION: As currently configured, the internally recording receiving system has a 96-element bottom-laid horizontal array and two vertical arrays having 32 and 64 elements. The vertical arrays are equipped with 2-D tilt sensors and depth sensors whose data are recorded with the acoustic data.

DESCRIPTION: The instrumentation suite includes battery-operated receiving systems and sound sources that are capable of autonomous operation. All timing functions, including acoustic transmission scheduling, waveform synthesis, and sampling of the received signals, are controlled by clocks having rubidium-standard accuracy. This feature permits measurement of absolute travel time and its variations to millisecond accuracy over the period of a month. An internally recording receiving system records up to 128 channels simultaneously, with 2.2 TB data storage capability. Transmission and signal recording functions can be programmed without the loss of timing accuracy. Since this system has no ocean surface expression, it can function during rough ocean conditions. A second receiving system, which simultaneously acquires 32 channels of 50 to 2000 Hz acoustic data, pictured on left above, telemeters digitized data to a recording station at typical ranges of 10 km, usually aboard a ship.

CONTACT:
S. Wolf • Code 7127 • (202) 767-3079
LOCATION:
Bldg. 76, Chesapeake Bay Detachment • Chesapeake Beach, MD

Structural Acoustics In-Air Facility

Structural Acoustics In-Air Facility

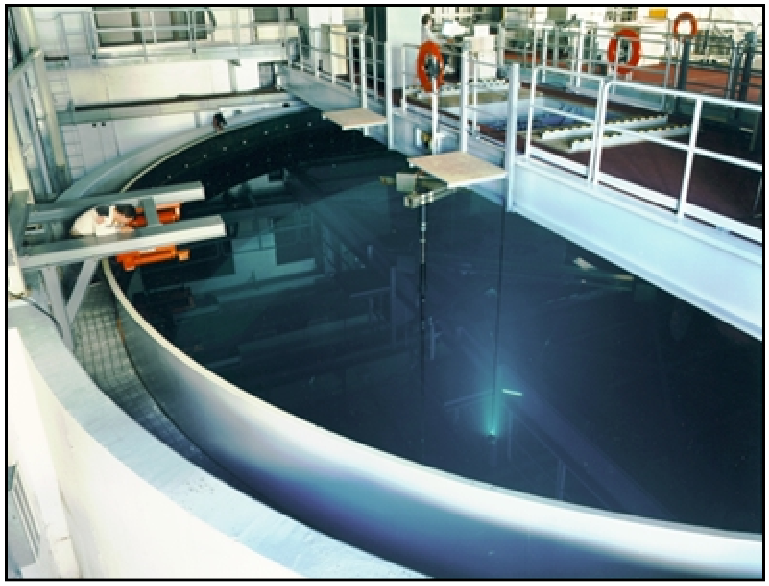
FUNCTION: Supports experimental research where broadband acoustic radiation, reflection, transmission, and surface vibration measurements are required. Typically, ultrahigh precision, highly spatially sampled measurements are conducted on scaled submarine structures, satellite payload fairings, active and passive material systems for sound control, and new transducer and sensor systems.

INSTRUMENTATION: Broadband source/receiver systems; large workspace (3-D) robotic scanners for NAH; scanning laser Doppler vibrometry (LDV); multiple workstations to support acquisition, analysis, calculations, and visualization; and structural acoustic codes: SARA2D, SARA3D, AXAR, NASHUA, and SONAX.

DESCRIPTION: The large, acoustically treated facility is 50 × 40 ft and 38 ft high. The laboratory is instrumented with precise acoustic and vibration measurement systems. These include large workspace robotic scanners capable of generating near-field acoustic holography (NAH) radiation, reflection, and transmission databases. In addition, three-axis laser vibrometers are used to generate very highly sampled surface vibration maps.

CONTACT:
B. Houston • Code 7136 • (202) 404-3840
LOCATION:
Bldg. 71 (high bay area) • NRL, Washington, DC

Laboratory for Structural Acoustics



Laboratory for Structural Acoustics

FUNCTION: Supports experimental research where acoustic radiation, scattering, and surface vibration measurements of fluid-loaded and nonfluid-loaded structures are required. Typically, ultra-high-precision measurements are conducted in this pristine laboratory environment using submarine hull backing impedance simulators, torpedoes, scale-model submarine structures, and deactivated mine targets.

INSTRUMENTATION: Networked-based automated data acquisition and process control including extensive use of robotic scanners. Other attributes and resources include: compact measurement ranges using nearfield sources and receivers; multiaxis Doppler vibrometers for non-contact surface motion measurements; extensive interferometric fiber optic sensor instrumentation; a 64-channel Motorola DSP 96002 matrix processor that supports MIMO control applications using state space FIR, IIR, or adaptive controllers; multiple workstations to support acquisition, structural acoustics calculations, and visualizations; a file server with more than 500 GB of storage; and structural acoustics codes: SARA2D, SARA3D, AXAR, NASHUA, and SONAX.

DESCRIPTION: The large acoustic tank, the core research capability for in-water structural acoustics studies, is 55 ft in diameter, 50 ft deep, and contains 800,000 gal of deionized water. The entire tank is vibration and temperature isolated. The laboratory is instrumented with precision measurement systems that include large workspace in-water robotic scanners capable of generating nearfield acoustic holography (NAH) radiation and scattering databases.

CONTACT:
B. Houston • Code 7136 • (202) 404-3840
LOCATION:
Bldg. 5, Rm. 200 • NRL, Washington, DC

Shallow Water Acoustic Laboratory

Shallow Water Acoustic Laboratory

FUNCTION: Supports experimental research where high-frequency acoustic scattering and surface vibration measurements of fluid-loaded and nonfluid-loaded structures are required. Typically, ultra-high-precision measurements are conducted in this pristine laboratory environment when acoustic interactions with sediments are important.

INSTRUMENTATION: Networked-based automated data acquisition and process control including extensive use of robotic scanners. Other attributes and resources include: broadband source/receiver systems; compact measurement ranges using near-field sources, receivers, and projection algorithms; multiaxis Doppler vibrometers for noncontact surface motion measurements of porous media water interfaces; multiple workstations to support acquisition analysis, calculations, and visualizations; structural acoustics codes: SARA2D, SARA3D, AXAR, NASHUA, and SONAX.

DESCRIPTION: This facility includes a large concrete pool (250,000 gal of deionized water) equipped with high-resolution, computer-controlled target source and receiver manipulators. It is used for high-frequency acoustic scattering characterization of scale-model submarines and deactivated mine targets. The pool bottom has a deep, sandy bottom and a high-resolution Cartesian nearfield acoustic holography (NAH) scanner to accommodate the controlled acoustic study of buried and near-buried mines.

CONTACT:
B. Houston • Code 7136 • (202) 404-3840
LOCATION:
Bldg. 71, Rm. 2214 • NRL, Washington, DC

Multichannel Acoustic Data Processing Laboratory

Multichannel Acoustic Data Processing Laboratory

FUNCTION: Study signal and noise characteristics and their effects on both active and passive sonar systems. The facility provides researchers the flexibility to process and analyze data from existing, prototype, and experimental sonar arrays and to implement and test advanced signal processing algorithms for Navy implementation.

INSTRUMENTATION:

- Primary data acquisition system
  - – Motorola PowerPC 604 single-board computer
  - – Pentek Model 4270 Digital Signal Processor with quad TI C40 processors
  - – 100 Mb/s Ethernet interface
  - – VxWorks real-time operating system
- Primary data processing system
  - – Silicon Graphics Octane workstation with dual R12000 processors
  - – 1 GB main memory
  - – 200 GB disk storage
  - – 100 Mb/s Ethernet interface

DESCRIPTION: The laboratory houses a network of computers designed to process and analyze multichannel acoustic data collected at sea. Capabilities include VME-based data acquisition systems and UNIX workstations with high-speed 3-D graphics connected to a Fast Ethernet local area network. Data acquisition systems feature a real-time operating system, digital signal processor boards, and high-speed disk storage. The system accepts analog or digital data from a wide variety of sources and can apply a variety of signal processing algorithms.

CONTACT:
D. Dundore • Code 7141 • (202) 767-5769
LOCATION:
Bldg. 2, Rm. 134 • NRL, Washington, DC

Autonomous Acoustic Receiver (AAR) System

Large (10-ft diameter) buoy at sea, configured with a 0.6-m dish for satellite link to NRL

FUNCTION: Collects underwater acoustic data and oceanographic data. Data are recorded onboard an ocean buoy and can be telemetered to a remote ship or shore station in real time. The system can be configured with a satellite link for command-and-control and data download. It can operate unattended for periods of up to one month.

DESCRIPTION: The heart of the system is the data acquisition unit (DAU) containing the analog-to-digital converters for 64 channels at rates up to 8192 samples per second. One 64-element or two 32-element acoustic receive arrays can be attached to this DAU: if used vertically, there is also capability to add four tilt/head/depth sensors spaced throughout the vertical array. Once digitized, the data are sent up a 2000-ft fiber optic umbilical cable to a surface buoy, where it is stored on hard disk. The data can then be telemetered to another location, with an option to use a larger buoy that provides a satellite link to a receive station at NRL. The line-of-sight/satellite link can also be used to send command and control information to the system.

INSTRUMENTATION:
- 16-bit, 8192 samples per second, 64-channel DAU
- 64-element, 1.25-m spacing acoustic receive array
- 32-element, 2.5-m spacing acoustic receive array
- 32-element, 5-m spacing acoustic receive array
- 2000-feet fiber optic double-armored umbilical cable
- Large (10-ft diameter) buoy with satellite receive and transmit capability and limited line-of-sight capability (power provided by battery/diesel-electric system)
- Small battery-powered buoy with enhanced line-of-sight capability
- Command-and-control/data downlink station with GPS-linked steerable, directional antenna (for remote ship or shore station).

CONTACT:
M. Nicholas • Code 7145 • (202) 404-4826
LOCATION:
Chesapeake Bay Detachment • Chesapeake Beach, MD

Salt Water Tank Facility

The main salt water tank provides excellent optical access to the controlled saline environment

FUNCTION: Provides a controlled environment for studying complex bubble-related processes found in the ocean. It is an experimental pool facility for studies of underwater acoustics, fluid dynamics, and air-sea interface environmental topics, under saline conditions. This facility is currently being used to study the acoustics of bubbly media.

INSTRUMENTATION:

- Acoustic sources, amplifiers, and hydrophones spanning 1 Hz to 700 kHz
- Environmental sensors to measure water temperature, salinity, dissolved gas concentrations, and surface tension
- Digital holographic imaging system to size particles down to ~5 μm
- Two high-speed digital cameras providing image acquisition up to 2000 full frames per second
- LabVIEW-based data acquisition system with Fibre-RAID storage and laboratory-wide network access
- Brickwall filters, digital and analog oscilloscopes, data loggers, power supplies.

DESCRIPTION: The main salt water tank measures 20 × 20 ft square × 12 ft high, with four 12 × 8 ft windows on each of the vertical walls. The water is recirculated every 10 h through particulate and UV filters, and the tank contains a high-capacity water chiller for controlling temperature. A separate chiller independently handles the air temperature. Catwalks and a gantry provide access around and over the main tank, and a three-axis computer-controlled positioning system with four independent stages places and moves equipment within the tank. The tank is contained within a thermally insulated 50 × 26 ft laboratory area furnished with an overhead crane, a staging area, and a 20 × 10 ft room for instrumentation and data analysis.

CONTACT:
M. Nicholas • Code 7145 • (202) 404-4826
LOCATION:
Bldg. 2 (west high bay) • NRL, Washington, DC

Tactical Oceanography Simulation Laboratory and Wide Area Network (TOSL/TOWAN)

The Tactical Oceanography Simulation Laboratory and Wide Area Network (TOSL/TOWAN)

FUNCTION: The Tactical Oceanography Simulation Laboratory and Wide Area Network (TOSL/TOWAN) form a modeling and simulation architecture. It consists of a set of tools that provide exact recreations of oceanography, bathymetry, geophysical, and acoustic data-coupled sensor system characteristics. TOSL/TOWAN features a high-performance data delivery and computational capability to provide real or near-real-time calculations in support of science and technology initiatives as well as training, war games, operations rehearsal, and other distributed simulation functions.

DESCRIPTION: TOSL/TOWAN is nonportable. The total facility consists of dedicated classified and unclassified space and an accompanying suite of equipment to equally support both environments. TOWAN consists of two Silicon Graphics Challenge S server systems, each attached to an external disk tower for mass storage, access, and retrieval. The TOSL consists of multiple high-end visual workstations, a multiple and parallel processing capability, and data analysis tools fully connected to the environmental data repository. Replica capability exists in both a classified and unclassified environment. Unclassified access is provided via T-1 network capability, and classified access is provided via SIPRNET. Numerous other dedicated workstations, along with peripheral equipment including scanners, digitizers, and multiple color and black-and-white printers, are contained within the facility.

CONTACT:
J. Ellis • Code 7183 • (228) 688-4314
LOCATION:
Bldg. 1008, Rm. 101 (unclassified)/Rm. 105 (classified) • Stennis Space Center, MS

Shallow-Water High-Frequency Measurement Systems

Shallow-Water High-Frequency Measurement Systems

FUNCTION: Supports a broad range of shallow-water high-frequency research programs. Those objectives range from acquiring a fundamental understanding of the physics of shallow-water propagation and boundary interactions to applied mine countermeasure and torpedo issues. The development of these systems has made NRL a leader in high-frequency shallow-water environmental acoustics research. Scattering and propagation measurements have been conducted in areas that ranged from the Gulf of Mexico to the Mediterranean. The data have been used in synthetic aperture sonar and torpedo simulations and design.

INSTRUMENTATION: These systems include high-resolution source and receiver combinations that operate in the shallow to very-shallow-water (7 to 30 m) coastal areas.

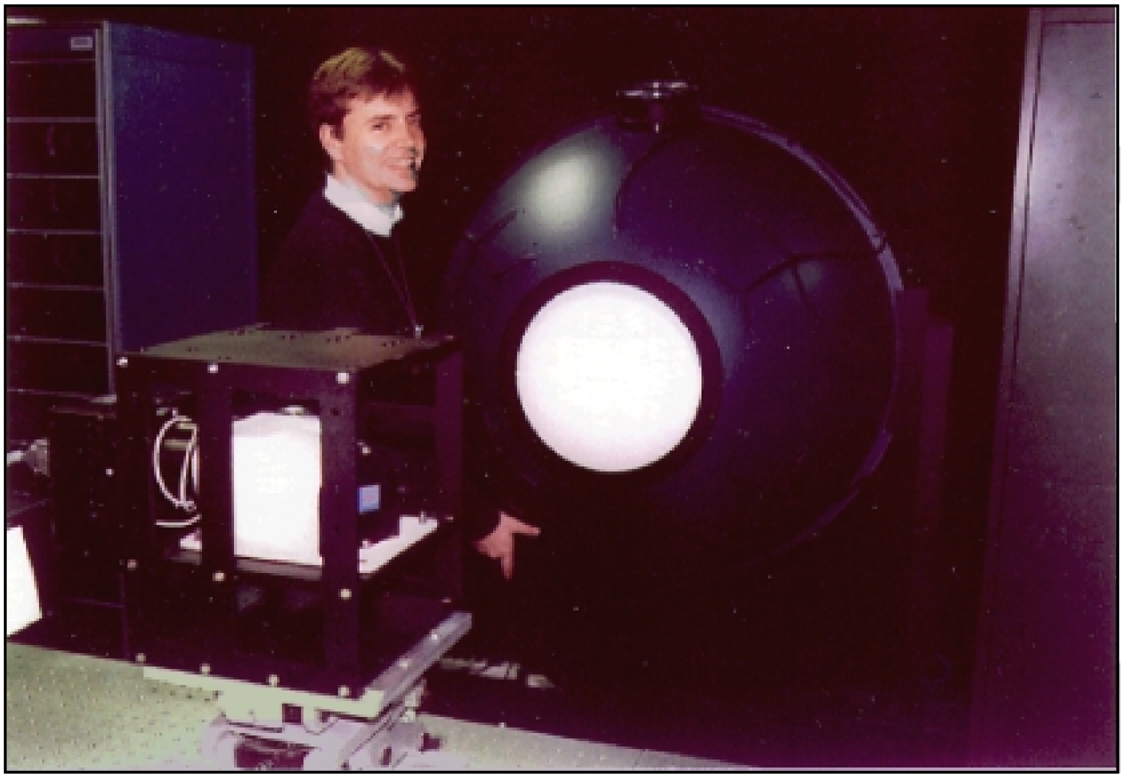
DESCRIPTION: These systems cover the 18 to 200 kHz frequency range. System control and data acquisition is carried by fiber optic cables that terminate in a portable instrumentation van where it is digitized and recorded on optical disks.

CONTACT:
S. Stanic • Code 7184 • (228) 688-5235
LOCATION:
Outside yard • NRL, Stennis Space Center, MS

Remote Sensing Division

- Optical Spectral Measurements Facility
- Naval Prototype Optical Interferometer
- Free Surface Hydrodynamics Laboratory

Optical Spectral Measurements Facility



Large blackbody calibration sphere

FUNCTION: Establishes and maintains procedures for calibrating in-water radiometers and hyperspectral imagers. Such calibration is needed for both research use of the sensors and to maintain traceability to National Institute of Standards Technology (NIST) calibration devices and standards.

DESCRIPTION: The facility consists of a precise optical bench with spectrometers, calibration lamps, and blackbody calibration spheres required to establish wavelength and intensity calibration of optical and near-infrared sensors. All components are cross-calibrated to NIST Standard FEL lamp using a stable reference detector. Calibration procedures meet or exceed NIST and NASA requirements. The laboratory is an official SeaWiFS calibration facility, and participates in NASA calibration “round-robin” calibrations. It has been used to calibrate all three versions of the PHILLS hyperspectral instruments: Slow Scan Spectrometer, HYCORDER and Ocean PHILLS. It will be used to calibrate the Coastal Ocean Imaging Spectrometer (COIS) on the NEMO satellite.

CONTACT:
C. Davis • Code 7203 • (202) 767-9296
LOCATION:
Bldg. 2, Rm. 210 • NRL, Washington, DC

Naval Prototype Optical Interferometer (NPOI)

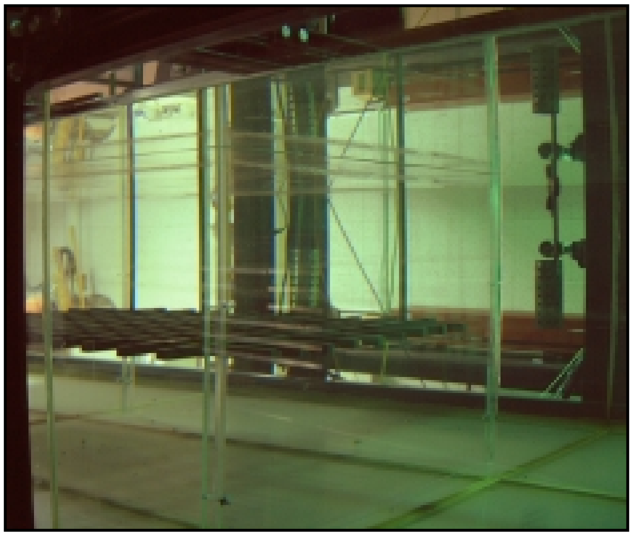
The NPOI, located on Anderson Mesa near Flagstaff, AZ, is the largest operating optical telescope in the world

FUNCTION: Used for astrometry and astronomical imaging, the NPOI is a distributed aperture optical telescope. It is operated for astrometry by the U.S. Naval Observatory. Research into optical imaging and astronomical research is conducted by NRL.

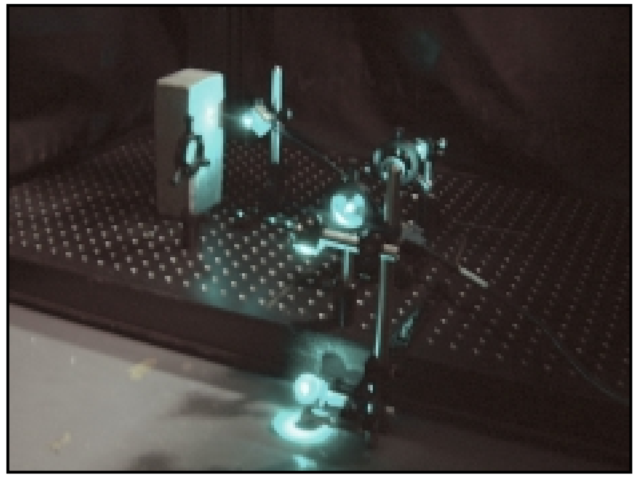
DESCRIPTION: The NPOI is a Y configuration of optical sidereostats. The inner fixed stations are used for astrometry while stations on the outer arms, out to an eventual separation of more than 300 m, are used for imaging stars. The stations are connected by vacuum beam lines. Fast delay lines in the main control building and long delay lines outside are used to adjust the optical phases to allow coherent combinations of up to six sidereostats.

CONTACT:
L. Rickard • Code 7210 • (202) 404-7877
LOCATION:
Bldg. 2, Rm. 283A • NRL, Washington, DC

Free Surface Hydrodynamics Laboratory



Tank facility with the grid turbulence generator installed



Optics, located under the tank, that illuminate the flow

FUNCTION: Investigates processes and interactions at the ocean's surface and compares measurements to numerical calculations. Typical investigations include the development of small capillary waves, heat and momentum flux through the surface, and signatures of turbulent flow.

INSTRUMENTATION: Two high-sensitivity infrared cameras, a high-speed video camera, the Particle Imaging Velocimetry System, and a Langmuir Trough.

DESCRIPTION: The laboratory is located in Bldg. 2. It contains a number of instrumented tanks including a large 10 × 10 × 5 ft tank with a grid turbulence excitation facility.

CONTACT:
R. Handler • Code 7253 • (202) 767-2457
LOCATION:
Bldg. 2, Rm. 131 • NRL, Washington, DC

Oceanography Division

- Environmental Microscopy Facility
- Ocean Dynamics and Prediction Network
- Visualization Laboratory
- Littoral Current Measurement Facility
- Scanning Slope Sensing and Wave Gauge Array Buoy
- Salinity Temperature and Roughness Remote Scanner
- Ocean Color Facility
- Ocean Optics Instrumentation Systems

Environmental Microscopy Facility

Environmental Microscopy Facility

FUNCTION: Provides high-resolution (5-nm) images and elemental composition (elements heavier than sodium) of hydrated specimens, including biological materials. The facility is essential for demonstrating spatial relationships between microorganisms and substrata and for investigating biofouling, bioremediation and biodeterioration.

INSTRUMENTATION:

- Environmental scanning electron microscope equipped with an energy-dispersive x-ray detector and an image acquisition and archive system
- Laser confocal scanning microscope

DESCRIPTION: The Environmental Microscopy Facility is equipped to examine the spatial distribution of microorganisms in biofilms and their impact on microbiologically influenced corrosion, biomineralization, and bioaccumulation. The environmental scanning electron microscope (ESEM) with a differential pumping system permits a 2-D examination of viable cells and a precise mapping of associated elements. The ESEM has been used to determine failure mechanisms for welded stainless steels, fiber-reinforced polymers, coatings, sealants and emulsifiers. The laser confocal scanning microscope provides a 3-D examination of microbial substrata relationships.

CONTACT:
B. Little • Code 7303 • (228) 688-5494
LOCATION:
Bldg. 1009, Rm. B115 • NRL, Stennis Space Center, MS

Ocean Dynamics and Prediction Network

Central elements of the Sun and Alpha Workstation clusters, and DLT tape library

FUNCTION: Provides general-purpose computer services to branch personnel for program development, graphics, data processing, storage, and backup. Provides network connectivity to other Navy sites, to the DoD High Performance Computing centers, and to the Internet.

INSTRUMENTATION:
- Sun and Tatung SPARC and UltraSPARC workstations and servers
- Microway dual-processor Alpha compute-servers
- ATL 320-slot, 4-drive DLT tape library
- Marconi routers and ATM switches
- Color and black/white printers

DESCRIPTION: The workstation network includes 90 UltraSPARC and SPARC workstations and servers, and 9 Alpha servers, plus all connected peripherals and the connecting network. More than 18 TB of Fibre-Channel and SCSI disks provide storage. Systems are linked by Fast Ethernet, FDDI, and ATM at speeds from 100 Mbps to 622 Mbps. Central disk storage is on a Veritas high-availability cluster. UltraSPARC workstations are configured in a Sun HPC cluster. Operating systems in use include Sun's Solaris and Linux.

CONTACT:
M. Peffley • Code 7320 • (228) 688-4895
LOCATION:
Bldg. 1009 (C-Wing) • NRL, Stennis Space Center, MS

Visualization Laboratory

Visualization Laboratory in presentation mode using Hum animating 8000 × 4600-sized images from the 1/32° Global Navy Layered Ocean Model

FUNCTION: Provides a visual means of quality control of ocean model results and the ocean model's forcing components. Provides visualization to the desktop where possible. Provides access to video, other digital media, and poster printing for presentation needs.

INSTRUMENTATION:

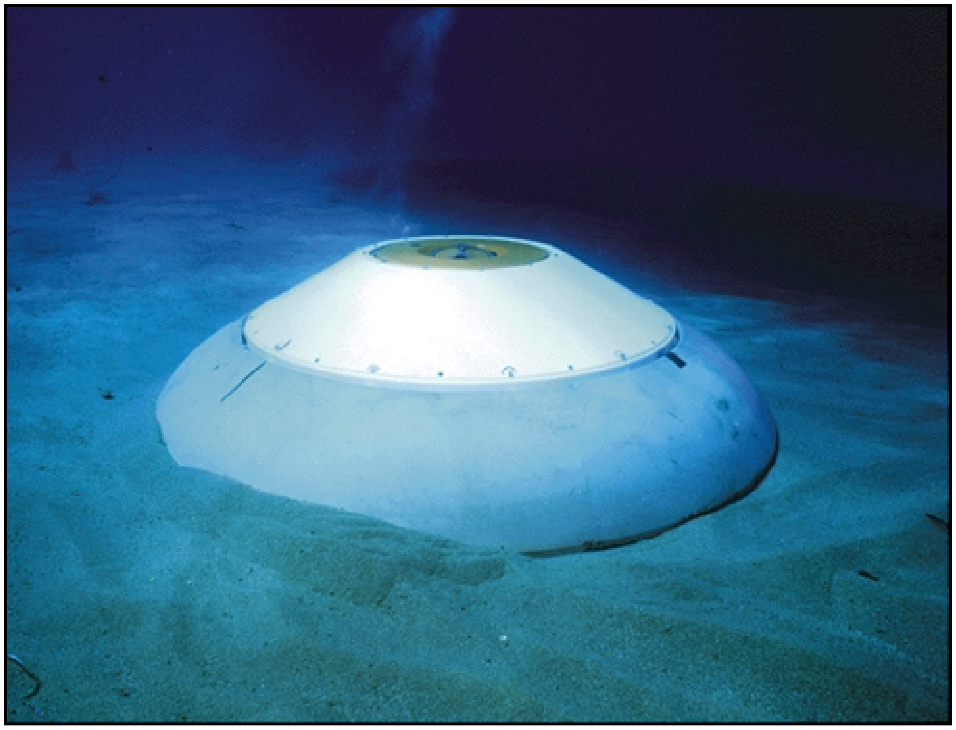
- SGI Onyx2 with Infinite Reality 3D graphics
- Sun Ultra 2 workstation
- Precision 610 dual 550 MHz Xeon with 512 MB memory and Geforce2GTS graphics for Windows NT and Linux
- ASL 250 Marque with dual 933 Intel Pentium III and 2 GB memory with Geforce2GTS graphics for Linux
- Video equipment includes: S-VHS, Beta SP, Sony Laserdisk, RGB spectrum scan converter, and Pinnacle's DC2000 system under Windows NT to generate Mpeg2, AVI, and quicktime files
- HP2500cp large-format printer for poster printing

DESCRIPTION: The Ocean Dynamics and Prediction Branch Visualization Laboratory is housed in C-wing of Bldg 1009 at the Stennis Space Center. The room dimensions are approximately 24L × 22W × 10H. It has an 8 × 8-ft rear-screen projection system with folded optics centered in the back of the room. The projector is a Barco 1208s and is used in two modes. The first mode is a large-presentation screen with inputs from the room's workstations. In the second mode, it is like a one-wall CAVE with head tracking and wand control. The one-wall CAVE-like device uses Crystal Eyes for stereo viewing.

Ocean model visualization software includes XVision by Baird.com and Hum by Rotang.com. Xvision is a multiple ocean model visualization package that handles finite-difference, finite-element, and curvilinear grids. Hum handles very large images and allows pan and zoom while animating images as large as 8000 × 4600. It is being refined for high-performance RAID/JBOD and multiprocessor machines for long time series of 2D data.

CONTACT:
P. Flynn • Code 7320 • (228) 688-6125
LOCATION:
Bldg. 1009, Rm. C-105 • NRL, Stennis Space Center, MS

Littoral Current Measurement Facility



Barny trawler-resistant, ADCP bottom mount deployed on the sea floor

FUNCTION: Measures ocean current measurements throughout most of the world's shallow seas and shelves. Twelve units are available for positioning on the sea floor where they measure ocean currents and sea-surface height. The units contain internally recording instruments, and may be left in place for periods of up to several months.

INSTRUMENTATION: Barnys host the following instruments, which are part of the facility:
- One ADCP—RD Instruments, Sentinel model 300, 600, or 1200 KHz, some capable of measuring surface wave spectra as well as currents
- One wave-tide gauge—Sea-Bird model 026
- Two acoustic releases—EdgeTech model 8202 or AMTR200

DESCRIPTION: Each unit, called a Barny because of its barnacle-like shape, consists of three major components: a circular outer cement ring for ballast and impact protection, a buoyant main instrument housing, and a pop-up float. An on-board Acoustic Doppler Current Profiler (ADCP) measures currents throughout the water column by an acoustic Doppler backscatter technique. The centrally located pop-up float surfaces on acoustic command, bringing with it a line for recovering the rest of the unit. The unit's overall low, smooth shape makes it very unlikely to be affected by fishing trawlers—a feature critical for instrument survival in coastal waters. Barnys were developed through a Cooperative Agreement between NRL and SACLANT Research Centre in Italy.

CONTACT:
H. Perkins • Code 7332 • (228) 688-5907
LOCATION:
Bldg. 1009, Rm. B155 • NRL, Stennis Space Center, MS

Scanning Slope Sensing and Wave Guage Array Buoy (SSSWGAB)

The Scanning Slope Sensing and Wave Gauge Array Buoy

(a) Readying for deployment into the ocean

(b) In free-drifing operation

FUNCTION: Acquires in situ spatial properties of water waves. These wavelengths range from 4 mm to 1 m and cover the band of surface waves contributing to the ocean surface roughness responsible for air-sea transfers and ocean remote sensing.

INSTRUMENTATION: In addition to the wave sensors, the buoy carries a suite of environmental sensors (*above surface*: 2 sonic anemometers, thermometer, humidity sensor, video recorder; *subsurface*: acoustic current meter, thermometer, 2 pressure sensors, 2 accelerometers, video recorder).

DESCRIPTION: Short ocean waves are the primary contributors to the ocean surface roughness, which is of critical importance to the interpretation of ocean features from remote sensing, and to the understanding of air-sea interaction processes driving the ocean circulation and water wave evolution. The system is designed to measure the directional spectrum of short surface waves. The resolved spectral band, 0.004 to 1 m, is of extreme importance to the determination of ocean surface roughness related to air-sea interaction and ocean remote sensing. Two different measurement techniques are used: optical scanning slope sensing for shorter waves (0.4 to 10 cm), and displacement sensing using a thin wire gauge array for longer waves (10 cm to 1 m). The sensor modules are carried on a wave-following platform. To reduce flow disturbance from the sensor platform, the system operates in free-drift mode.

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Salinity Temperature and Roughness Remote Scanner (STARRS)

The STARRS system is flown beneath the fuselage on a variety of aircraft

FUNCTION: Provides spatially continuous high-resolution surface salinity imagery in a synoptic manner from small aircraft. Its output complements data collected from ship-based and moored systems, puts those data sets into synoptic context, and provides key information for assimilation into predictive models of physical fields including currents, temperature, salinity, and sound speed in the littoral and open oceans.

INSTRUMENTATION: (a) A multibeam 1.4 GHz L-band radiometer based on a low noise microstrip patch antenna for the primary salinity/brightness/temperature measurement. (b) A two-channel split-window infrared radiometer for sea surface temperature. (c) A single-beam multichannel C-band radiometer for estimates of sea surface roughness. The secondary subsystems ((b) and (c)) provide useful oceanographic information in their own right in addition to being key parameters in the retrieval of salinity from the primary subsystem (a).

DESCRIPTION: STARRS is an imaging sensor that provides complete areal coverage of surface salinity in a swath twice as wide as the aircraft's altitude. The swath is resolved into several adjacent cells, and swaths can be quickly flown adjacent to each other. STARRS includes advanced primary and secondary measurement components to assure salinity retrieval with total noise levels less than a few tenths psu under a wide range of environmental conditions. The most persistent force driving currents in the littoral is due to density differentials between water masses. These are caused by the flux of low salinity waters from bays and rivers to the coastal zone as well as the contrasts between shelf and open-ocean waters. Similar contrasts drive large-scale open-ocean currents. STARRS' capabilities allow researchers to routinely obtain high-resolution imagery in a synoptic fashion.

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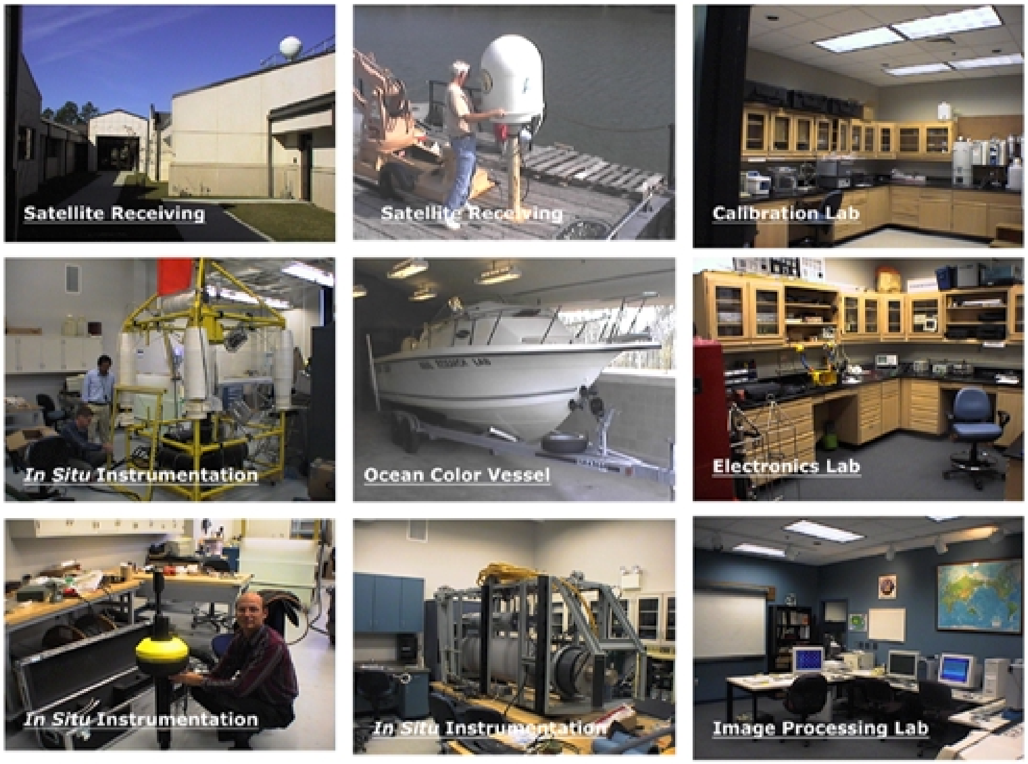
Ocean Color Facility



Ocean Color Facility

FUNCTION: Maintains a state-of-the-art image processing, instrumentation, and satellite receiving capability. The laboratory is developing advanced algorithms for space and aircraft ocean color sensors (SeaWIFS, MODIS, MOS, AVIRIS, Phills, HYDICE).

INSTRUMENTATION: The laboratory has both fixed and shipboard antenna systems to support global experiments. It maintains a host of over 30 workstations and an archive of 700 GB of ocean color imagery. The laboratory also maintains an advanced at-sea instrumentation and calibration laboratory specializing in coastal ocean color. Facilities include spectral absorption, scattering, and reflectance measurements, and laboratory spectrometers.

DESCRIPTION: The laboratory is currently a SeaWIFS NASA receive site for real-time data capture and processing of ocean color imagery. Real-time ocean color products are used for ship sample collection experiments. The laboratory processes more than 4 GB of imagery daily, coming from collection systems all over the world. These data are used for the development, tuning, and validation of advanced algorithms relating spectral signatures to ocean properties and processes.

CONTACT:
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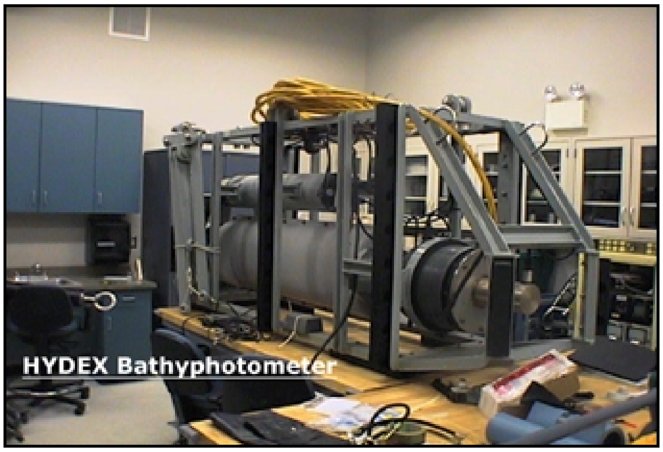
Ocean Optics Instrumentation Systems



Ocean Optics Instrumentation Systems

FUNCTION: Instrumentation suites for a wide variety of measurements to characterize the ocean's optical environment. These packages have been developed to measure optical characteristics from the bioluminescent potential of the depths to the radiometric properties of the sea surface.

DESCRIPTION: The ocean surface photic region is the prime interest as it relates to ocean color from satellite and biological application in numerical modeling. Recently, small, lightweight packages have been developed for use in the near-shore coastal water. NRL also maintain capabilities for open-ocean measurements, airborne remote sensing, and airborne expendable optical systems.

INSTRUMENTATION: Measurements of the inherent optical properties of attenuation, absorption, and scattering are routinely performed in the field, in addition to the measurement of the apparent radiometric quantities of radiance and irradiance. Instruments include WETLabs AC9 (9 wavelength attenuance and absorption meters); WETLabs ECOVSF and VABAM (angular dependent scattering); Satlantic SPMR (SEAWifs wavelength radiance and irradiance profiles); Satlantic HTSRB and K-Chain (near-surface hyperspectral near-surface light field); HYDEX (bioluminescence potential); WETLabs SAFire (multiple wavelength; SeaTech CHL a fluorometers; ASD radiometers (surface leaving radiance and reflectance).

The integration of these instruments into oceanographic measurement packages and data acquisition systems is an ongoing process at NRL's Ocean Optics facility.

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Marine Geosciences Division

- Electron Microscopy Center
- Sediment Physical and Geoacoustic Properties, and Sediment Biogeochemistry Laboratories
- Moving-Map Composer Facility

Electron Microscopy Center

JEOL JEM-3010 TEM

FUNCTION: Performs basic and applied research in areas of marine geosciences, geophysics, physics, and microbiology using microanalytical techniques.

INSTRUMENTATION: The facility has a JEOL JEM-3010 transmission electron microscope (TEM) equipped with an energy-dispersive x-ray spectrometer (EDXS), Gatan Model GIF200 (Gatan Imaging Filter) for energy filtered imaging and electron energy loss spectroscopy (EELS), and scanning coils for scanning TEM mode. This TEM has a state-of-the-art environmental cell (EC) system with two interchangeable EC specimen holders. The center is also equipped with a Hitachi H-600 TEM and an environmental scanning electron microscope (ESEM).

DESCRIPTION: The Marine Geosciences Electron Microscopy Center has unique instrumentation in its environmental cell (EC) transmission electron microscope (TEM) system. The EC is of the closed-cell type and is fully computer-controlled. Unlike EC systems based on the principle of differential pumping, closed-cell EC systems require no modification to the TEM. Confinement of the pressurized environment within the EC is achieved with electron-transparent windows. Since the EC is self-contained within the specimen holder, the TEM can still be used for conventional transmission electron microscopy using conventional specimen holders without compromising resolution and analytical capabilities.

CONTACT:

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LOCATION:

Bldg. 1005, Rm. D-10 • NRL, Stennis Space Center, MS

Sediment Physical and Geoacoustics Properties and Sediment Biogeochemistry Laboratories

Sediment Physical and Geoacoustics Properties Laboratory

FUNCTION: Provides instrumentation and expertise for both biogeochemical experiments and analyses for the understanding of sediment early diagenesis, and for physical and geoacoustic characterization of marine sediments from all depths and regions of the oceans.

INSTRUMENTATION: Wet chemistry facility, centrifuge, spectrophotometer, benthic mesocosm tanks with circulating water, equipped with O_2 and pH microprofilers, a Geotek multisensor core logger, Faxitron x-radiography system, digital macro- and micro-photographic imagery systems, and geotechnical testing instrumentation that includes miniature vane shear and torvane, uni- and triaxial consolidation instruments, geoacoustic Hamilton frame, relative density shaker table, and Quantachrome Ultra-pycnometers (Model 1000). Sediment textural analyses are routinely performed using standard sieves, pipette analysis, a computerized and instrumented in-house developed settling tube, and a Micromeritics Sedigraph, Model 5000ET.

DESCRIPTION: The sediment biogeochemical laboratory consists of benthic mesocosm tanks that simulate heavily bioturbated sediments. The sediment and interstitial waters are analyzed in the wet chemistry lab for their cation and nutrient content. The multisensor core logger measures profiles of compressional wave velocity and wet bulk density (by gamma ray attenuation) directly, and acoustic impedance and porosity indirectly; an X-ray radiography unit (Faxitron) provides images of sediment stratigraphy, bioturbation, and inclusions. Sediment cores are opened and split for visual classification, measurement of undrained shear strength via miniature vane and torvane, and subsampling for physical properties tests. Grain-size analyses for coarse sediments are performed by settling tube or standard sieve analysis, and silt and clay size particles are analyzed by Micromeritics Sedigraph. Average grain densities are measured via gas pycnometry using a Quantachrome Ultrapycnometer. Geoacoustic properties are measured using a Hamilton frame. Sediment compressional, undrained and drained shear strength, and geoacoustic properties are measured using 1-D consolidometers and triaxial testing machines.

CONTACT:
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Bldg. 1005 (B-Wing) • NRL, Stennis Space Center, MS

Moving-Map Composer (MMC) Facility

Moving-Map Composer Facility

FUNCTION: Develop, test, and transition software and algorithms to perform database design, data compression, data fusion, archival, retrieval and display. Demonstrate and evaluate prototype and next-generation digital moving-map capabilities, map design systems, and mission planning systems.

INSTRUMENTATION: The MMC facility includes multiple computer platforms running Unix, Linux, Windows NT, and OpenVMS operating systems.

DESCRIPTION: The MMC Facility is a 32 × 30-ft laboratory located in the D-wing of Bldg.1005 at the Stennis Space Center, MS. The facility is divided into four primary work areas to support the principal functions of the MMC team:

- Research into data compression and database design
- Development and transition of mission-specific aircraft optical disks for F/A-18 and AV-8B platforms
- Software and algorithm development in support of naval mission and map planning
- Developing, testing, prototyping and demonstrating parallel processing techniques to improve efficiency of existing bathymetric data processing systems.

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Marine Meteorology Division

- Satellite Data Ingest and Processing System
- Meteorological Computing and Archival Facility
- John B. Hovermale Modeling, Database, and Visualization Laboratory

Satellite Data Ingest and Processing System

Antenna receiving geostationary satellite data

FUNCTION: Collects and processes a unique global digital data set from multiple satellite sensors. The facility enables researchers to rapidly collocate multiple satellite sensors/channels for a wide range of METOC applications anywhere on the globe. Hardware/software compatibility with the Fleet enhances rapid prototyping and transition to operations.

INSTRUMENTATION: The facility includes two geostationary receiving systems to capture real-time GOES-West and GOES-East data. A polar orbiter antenna system collects data from NOAA and Defense Meteorological Satellite Program (DMSP) satellites. A suite of Unix workstations and software process these data streams and data from three other geostationary and four global polar orbiter satellite data sets. Collaborative agreements with other government agencies significantly reduce onsite infrastructure needs.

DESCRIPTION: The facility includes rooftop antennas to capture real-time GOES-West and GOES-East digital data. The ~30 GB/day data rate flows through hardware to frame and bit-sync the data located in the computer room. Digital data from three other geostationary satellites (GMS-5, Meteosat-7&5) are gathered from the Fleet Numerical Meteorology and Oceanography Center (FNMOC). The five geostationary satellites thus enable true global coverage with visible, infrared and water vapor channel data using SeaSpace's TeraScan software.

Real-time DMSP and NOAA polar orbiter satellite data are captured via a SMQ-11 system. NOAA data are available from a similar system in Norfolk, VA. Global near real-time DMSP polar orbiter data are also gathered via FNMOC. Near real-time Tropical Rainfall Measuring Mission (TRMM) polar orbiter data are collected from the NASA Goddard Space Flight Center.

CONTACT:
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LOCATION:
Bldg. 704 • NRL, Monterey, CA

Meteorological Computing and Archival Facility

Tape library of the Bergen Data Center

FUNCTION: Provides a data archival facility, the Bergen Data Center (BDC), for meteorological and oceanographic data. It also operates as a resource site for the Master Environmental Library (MEL), a distributed repository system of environmental information with a single user access site.

INSTRUMENTATION:The facility includes a SGI server, two Sun servers, and StorageTek tape libraries handling archives and backup for BDC. BDC storage capacity is 31 TB. Veritas Hierarchical Storage Manager (HSM), Netbackup, and First Watch software packages are used to manage data storage.

DESCRIPTION: The MEL facilitates discovery, access, subscription, and delivery of environmental information, products, and data wherever they are stored. It supports models and simulations for training, analysis, and acquisition through a single user interface to numerous DoD and non-DoD Resource Sites. MEL promotes interoperability among simulation users by facilitating reuse of environmental information, products, and data. MEL supports the warfighter as well as the non-DoD and commercial communities. At the BDC, data older than 30 days are physically archived within the HSM file systems but can also be retrieved logically on-line.

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LOCATION:

Bldg. 704, Rm. 260 • NRL, Monterey, CA

John B. Hovermale Modeling, Database, and Visualization Laboratory

Visualization display and recording device

FUNCTION: Provides computer facilities and expertise to support on-scene numerical weather predictions including access to operational Navy databases and state-of-the art visualization tools. This unique laboratory is sponsor-funded and provides support to NRL and other DoD researchers supported by ONR or SPAWAR.

INSTRUMENTATION: Silicon Graphics Inc., Sun, Hewlett-Packard, and Windows NT servers with live, global METOC data feed from Fleet Numerical Meteorology and Oceanography Center and other sources.

DESCRIPTION: This laboratory provides efficient access to unclassified and classified networks, databases, and computational resources. Access to these assets aids in the development, integration, and testing of a wide range of end-user applications including on-scene numerical weather prediction models, tactical environmental data servers, atmospheric analysis and nowcast systems, visualization applications and briefing tools, and web-based data and product dissemination capabilities. In addition to providing hardware resources and data for research projects and demonstrations, dedicated technical experts provide code examples and database consulting to on-site and off-site developers. A key to successfully demonstrating new and innovative capabilities to users and to sponsors is end-to-end data connectivity.

CONTACT:
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Space Science Division

- Cryogenic Sensor Test Facility
- Vacuum Ultraviolet Calibration/Testing Facility
- Solid-State Position-Sensitive Detector Evaluation Facility
- The Large Angle and Spectrometric COronagraph
- Rocket Assembly and Checkout Facility
- Solar Coronagraph Optical Test Chamber
- Space Instrument Test Facility

Cryogenic Sensor Test Facility

Laser photon source and He-3 cryostat in a shielded room

FUNCTION: Used for designing and testing hyperspectral (IR to X-rays) single-photon cryogenic detectors. These detectors can measure the "color" (energy) of individual photons without using dispersive elements such as diffraction gratings. The accuracy can be as high as 1 part in 10,000 for a 10 KeV photon. The facility provides a cryogenic environment for the detectors, ultra low-noise electronics, and a fast acquisition system.

INSTRUMENTATION: The He-3 cryostat provides access to temperatures as low as 0.3K. An X-ray source (Fe-55) can be placed inside the cryostat and covered or uncovered by external control. The cryostat has windows adjustable to external IR/visible/UV photons. A custom Nd-YAG laser (infrared radiation: λ=1.06 mm) with frequency doubling (green: λ=532 nm) and tripling (UV: λ=353 nm) produces trains of sub-nanosecond pulses. Cryogenic electronics include SQUID-array amplifiers, with current noise 2 pA/Hz$^{1/2}$, bandwidth > 10 MHz, input impedance 4-250 nH, and transimpedance gain 100-1000 Ω.

DESCRIPTION: The Cryogenic Sensor Test Facility is an electromagnetically screened room with a sub-Kelvin temperature cryostat, photon sources (X-ray, UV, optical and infrared photons), very low noise cryogenic and room temperature electronics, and a signal processing system. It was built to support the development of nondispersive single-photon detectors. It was initially based on superconducting tunnel junction designs for X rays, and later modernized for development of hyperspectral QVD detectors, which can cover a wide range of wavelengths from X rays to IR. In the QVD design, the energy deposited by a photon into the detector is thermoelectrically converted into the voltage with subsequent digital readout at the cold stage for a multipixel array configuration. Since the QVD is still at the developmental stage, the facility is very flexible and has tools and equipment that can be easily reconfigured and upgraded.

CONTACT:
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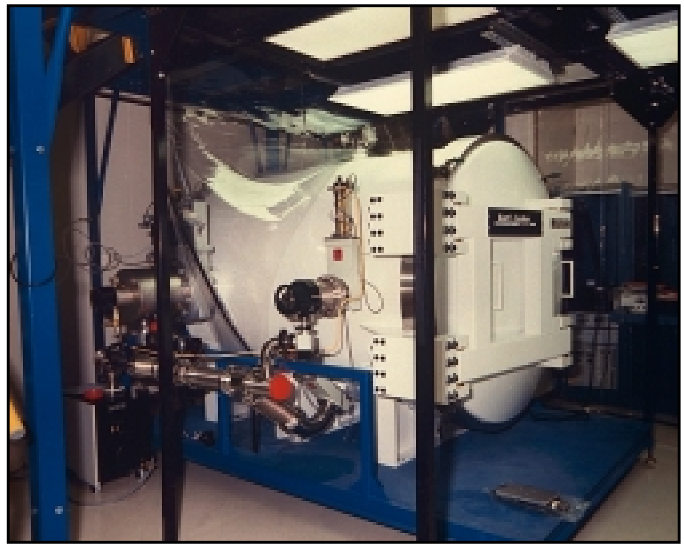
LOCATION:
Bldg. 209, Rm. 310A • NRL, Washington, DC

Vacuum Ultraviolet Calibration/Testing Facility

FUNCTION: Provides an oil-free high-vacuum chamber for vacuum ultraviolet calibration and testing of extreme and far ultraviolet (UV) sensors. The system is used to determine an instrument's optical characteristics by simulating the naturally occurring diffuse airglow emissions of the Earth's upper atmosphere. It is also capable of performing component-level testing and characterization of an instrument's individual optical components before instrument assembly

INSTRUMENTATION: The facility consists of three vacuum vessels specifically designed for the fabrication and testing of sensors and components operating in the 80 to 170-nm spectrum. The primary vacuum vessel is a 1.67-m diameter by 2-m long stainless steel tank. This chamber is evacuated using oil-free cryogenic, turbo and roughing pumps with a typical operating pressure of 1×10^{-6} Torr. Unltraviolet radiation is delivered into this system using two gas discharge lamps. The lamps can be configured for directed beam applications or as a diffuse source or both simultaneously. Inside the chamber are several motion stages for remote positioning of the instrument or component being tested. Another vacuum vessel in the facility includes a chamber for independently testing and assembling far ultraviolet sealed tube detectors. The facility includes a vacuum chamber dedicated to the deposition of thin film photocathodes and a 0.6-m diameter chamber for thermal vacuum testing components or small instruments that require stimulation of ultraviolet radiation.



Vacuum Ultraviolet Calibration/Testing Facility

DESCRIPTION: The Vacuum Ultraviolet Calibration Facility is a series of clean vacuum chambers capable of generating and detecting UV radiation required for optical calibration of space experiments. It was built to support the optical development, testing, and calibration of the Special Sensor Ultraviolet Limb Imager (SSULI). Using an advanced graphical interface, the facility can be easily reconfigured for a wide variety of UV measurements. A silicon carbide reflection diffuser provides diffuse radiation in the far and extreme UV portion of the spectrum. Calibrated reference detectors monitor the radiation levels during an experiment. Inside the chamber, precision translation and rotation stages allow motion of the test component along four independent axes. To minimize contamination, the end of the vacuum chamber is inside a Class 1000 clean room. The entire facility can be be used interactively, and work is in progress to automate the facility, allowing remote monitoring via a network connection.

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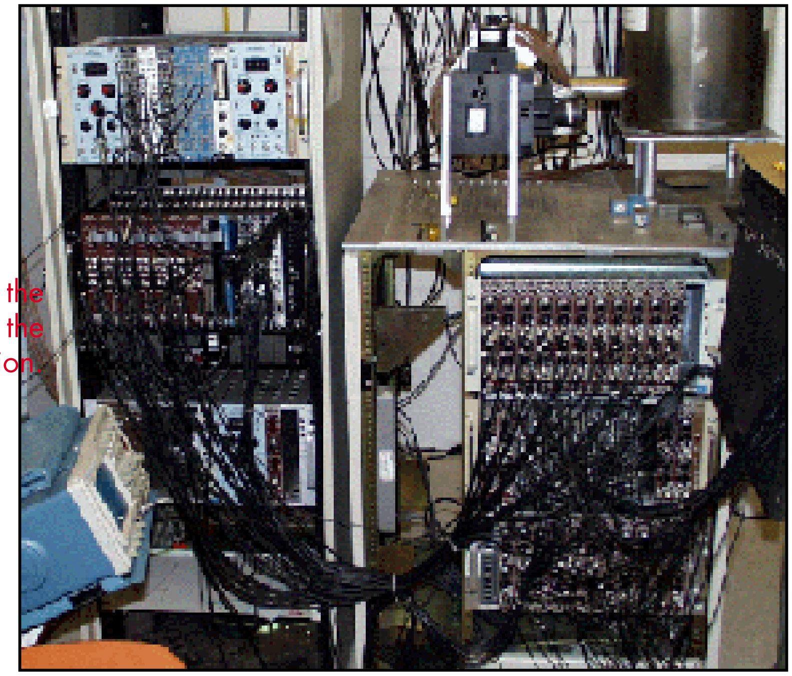
Solid-State Position-Sensitive Detector Evaluation Facility

The SHIMMER instrument, shown here in the laboratory, is being prepared for flight on the Space Shuttle and International Space Station.



CAMAC data acquisition system

FUNCTION: Develops position-sensitive radiation detectors for a diverse range of hard X-ray and gamma detection applications. New-technology detectors will push the capabilities of instrumentation in gamma-ray astrophysics, environmental remediation, nuclear nonproliferation, and medicine. The laboratory provides the electronics and handling capabilities to quickly and accurately test and evaluate a wide variety of new detector technologies.

INSTRUMENTATION: Our inventory includes many hundred low-noise preamplifiers, shaping amplifiers, discriminators, analog-to-digital converters, and time-to-digital converters. These are easily configured to support a variety of experimental needs. In addition, custom CMOS systems have been developed for particular applications, many of which can be used with a variety of detectors. Computer-controlled position tables provide the ability to scan detectors with collimated radioactive beams. Vacuum apparatus and thermal chambers permit testing detectors that operate at temperatures ranging from 77K through 373K. In addition, several imaging detectors are available, including 10 germanium strip detectors.

DESCRIPTION: The laboratory consists of several easily configurable data acquisition systems that can process spectroscopy signals from approximately 200 simultaneous channels. Several CAMAC and VME crates support much of this, in addition to a variety of specialized readout systems based on custom CMOS chips. Energy resolution of 1.4 keV FWHM in germanium has been achieved using room-temperature electronics. A variety of imaging germanium, silicon, and scintillation detectors are available that can be configured in coincidence or as stand-alone devices. The combination of these detectors permits the study of complicated systems such as a Compton telescope and coded-aperture imagers.

CONTACT:

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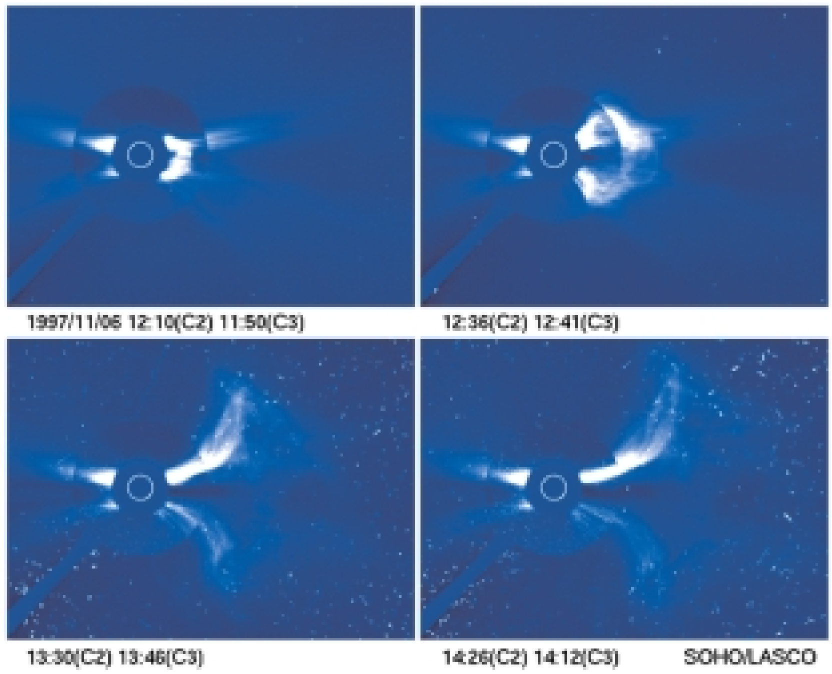
LOCATION:

Bldg. 209 • NRL, Washington, DC

The Large Angle and Spectrometric Coronagraph (LASCO)



Images of a coronal mass ejection that occurred on 6 November 2000

FUNCTION: Designed to answer some fundamental questions: How is the corona heated? Where and how is the solar wind accelerated? What causes coronal mass ejections, and what role do they play in the evolutionary development of large-scale coronal patterns?

INSTRUMENTATION: The LASCO instrument is a suite of three coronagraphs that image the solar corona from 1.1 to 32 solar radii. It is convenient to measure distances in terms of solar radii. One solar radius is about 700,000 km, 420,000 miles, or 16 arc min. The EIT instrument images the solar disk to 1.5 solar radii in four narrow wavelength intervals from 17.1 to 30.4 nm. These intervals roughly correspond to ionization temperatures of 60,000 K to 3 MK.

DESCRIPTION: The LASCO and EIT instruments are two of 11 instruments included on the joint NASA/ESA SOHO (Solar and Heliospheric Observatory) spacecraft. SOHO was launched on 2 December 1995 at 0808 UT (0308 EST) from the Kennedy Space Center, Cape Canaveral, Florida. The spacecraft is located about 1 million miles from Earth, between Earth and the Sun in a halo orbit about the L1 Lagrangian point. This point is where the gravitational and orbital forces are balanced. About 250 images are returned from LASCO and EIT each day, providing unprecedented views of the Sun and its corona.

CONTACT:
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LOCATION:
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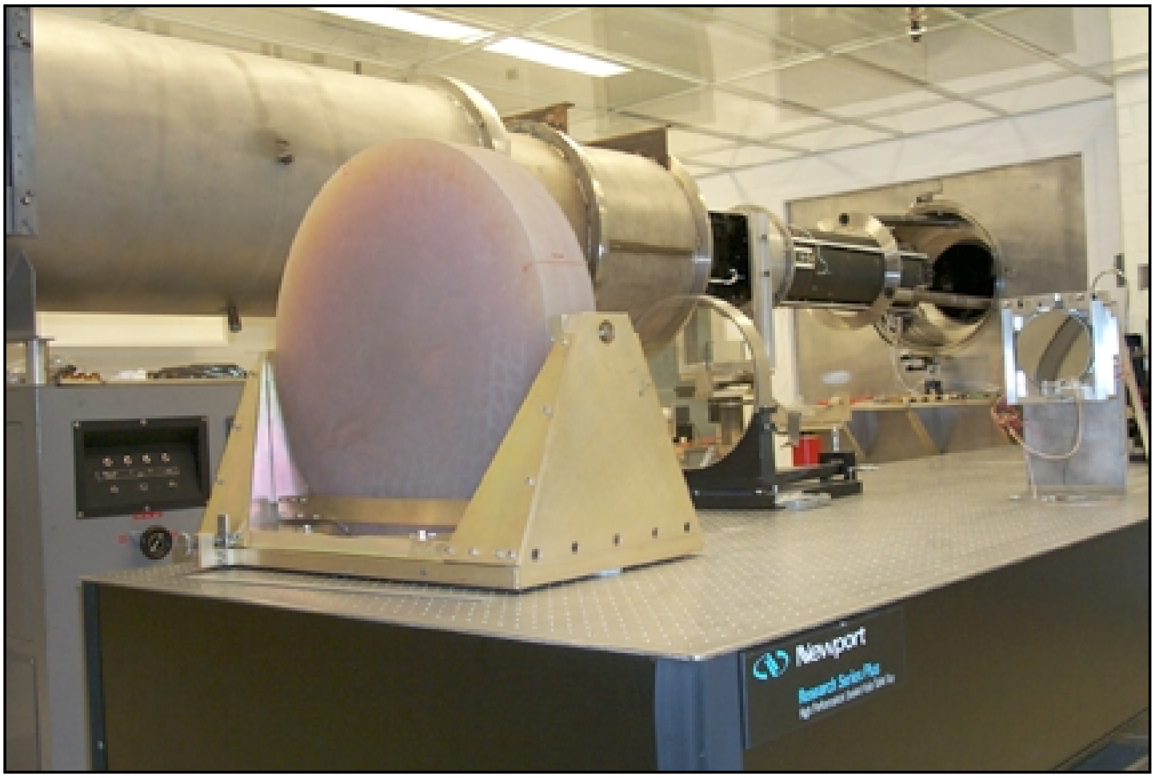
Rocket Assembly and Checkout Facility



Rocket Assembly/Checkout Facility

FUNCTION: Integrates, tests, and calibrates scientific instruments flown on sounding rocket payloads. The scientific instruments are assembled on an optical bench; the electronic components are installed and tested; and the instrument is moved to the vacuum calibration chamber for spectroradiometric calibration. When removed from the chamber, the payload is ready for shipment to White Sands Missile Range (WSMR), NM, for integration with the spacecraft and launch vehicle.

INSTRUMENTATION: Air hood, ultrasonic cleaner, particle counter, vacuum bake chamber with thermally controlled quartz crystal microbalance, oscilloscope, flight instrument computers

DESCRIPTION: The facility consists of six contiguous laboratory modules subdivided into a storage area, a gray room area, and a clean room. The storage area houses spare instrument components and intermittently used ground support equipment. The gray room area contains facilities to clean components before they enter the clean room and equipment used to ship the instrument to WSMR. The Class 100 cross-flow clean room is separated from the gray room by an air shower. The clean room contains three major stations: a clean bench for assembly of subsystems; a 12 × 4-ft optical bench for instrument assembly and electronic test of the instrument subsystems; and a vacuum chamber for vacuum focus and spectroradiometric calibration. The cryogenically pumped vacuum chamber is designed with a 30-cm diameter ultraviolet collimator at one end and a roll-off section that accommodates the entire flight instrument centered in the collimated beam at the other end.

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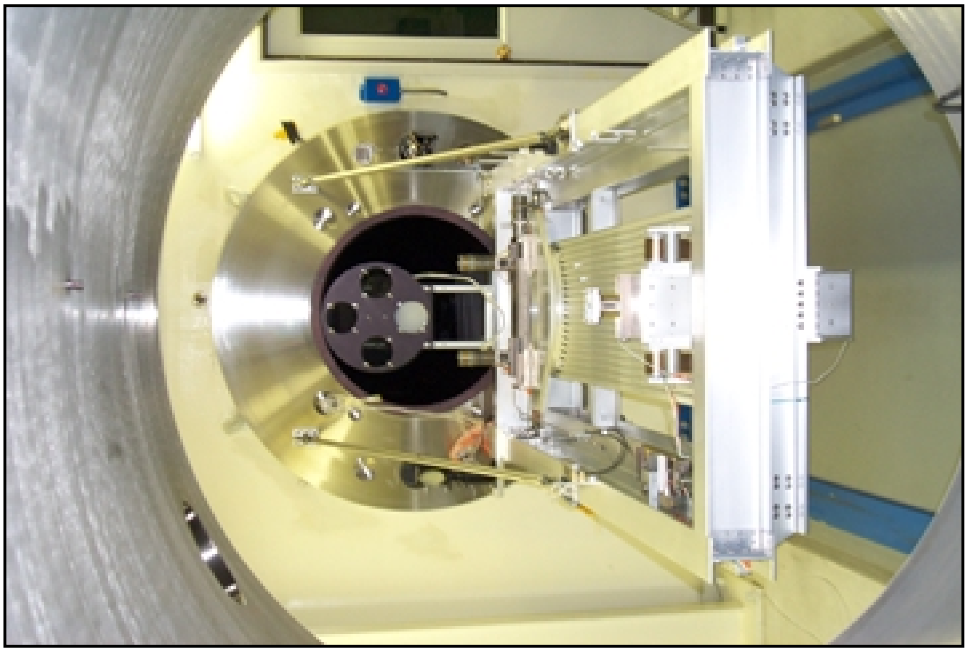
Solar Coronagraph Optical Test Chamber (SCOTCH)



Solar Coronagraph Optical Test Chamber

FUNCTION: Provides a facility for the assembly, test, and vacuum optical characterization of solar and coronal satellite instrumentation under ultraclean conditions.

INSTRUMENTATION: The SCOTCH is instrumented with temperature-controlled quartz crystal monitors and residual gas analyzers for real-time, quantitative measurements of volatile contamination. Various light sources can be introduced at one end of the 11-m chamber. This includes a solar spectrum simulator, the solar disk itself, as well as other visible and XUV sources. The chamber contains an instrument-pointing table capable of supporting payloads with a mass of 175 kg. The precision of the pointing table is <1 arc-second.

DESCRIPTION: The large Solar Coronagraph Optical Test Chamber (SCOTCH) is the primary test chamber located within a 400-ft^2 Class 10 clean room. This completely dry-pumped, 550 ft^3 vacuum chamber is maintained at synchrotron levels of cleanliness. Solar instrumentation up to 1 m in diameter and 5 m in length can be physically accommodated in the chamber. An instrument's optical performance is probed and calibrated with a variety of visible and XUV sources mounted on the chamber's 11-m beamline. The instrument is mounted on a precision pointing table equipped with motorized slides, which allows controlled adjustment of instrument pointing with sub-arcsecond precision under evacuated conditions. The main beamline is baffled to eliminate stray reflections from the beamline walls and minimize the effect of light scattered off the instrument surfaces. A solar disk stray light rejection of 10^{-12} was successfully measured in the Large Angle Spectroscopic Coronagraph (LASCO) C3 channel.

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Bldg. A13 • NRL, Washington, DC

Space Instrument Test Facility (SITF)

Space Instrument Test Facility

FUNCTION: Enables flight optics and sensors to be assembled and tested under conditions designed to minimize particulate and volatile contamination of the flight hardware. The SITF was used for the test and assembly of the Large Angle Spectrometric Coronagraph (LASCO) and is currently being used to develop and test the next generation of solar-space-based instrumentation.

INSTRUMENTATION: SCOTCH is instrumented with a temperature-controlled quartz crystal microbalance and a residual gas analyzer to monitor chamber and instrument outgassing. Electrical and liquid nitrogen vacuum feed-throughs are available through ports in the tank. A large retractable bell jar pulls back into the Class 10 instrument clean room to provide access to the instrument pointing platform. To facilitate instrument handling, assembly, and alignment operations, the clean room contains a 1.3 × 7-m vibration-isolated optical bench and an overhead crane adapted for clean room use with a 1 ton load capacity. A variety of calibrated optical sources, collimators, and theodolites are available to support in-air optical test, alignment and assembly operations.

DESCRIPTION: The SITF provides a clean, controlled environment for the optical calibration and assembly of modern space-based solar instrumentation. The unique requirements of this instrumentation require a rigorous approach to contamination control. The instrument vacuum test chamber, the Solar Coronagraph Optical Test Chamber (SCOTCH), forms the primary optical test chamber and is described more fully on the previous page. The instrument handling and assembly is conducted in a Class 10 clean room to reduce particulate generation. Airborne particulate levels are continuously monitored. To prevent hydrocarbon contamination, the clean room air is filtered through activated carbon filters located in the central plenum ducts. The facility also contains a small, well-instrumented thermal vacuum/bake test chamber. This allows characterization of outgassing of components and subassemblies prior to integration in the main instrument structure.

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NAVAL

CENTER FOR SPACE TECHNOLOGY

Code 8100 – Space Systems Development Department

Code 8200 – Spacecraft Engineering Department

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Space Systems Development Department

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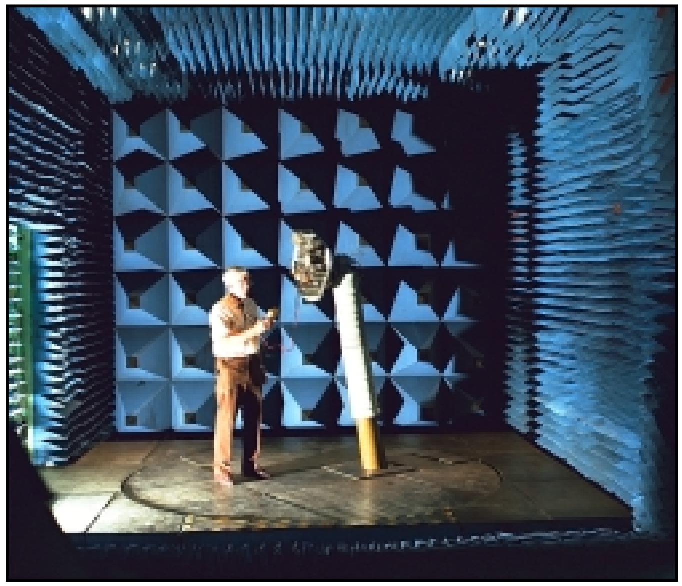
- Precision Clock Evaluation Facility

Precision Radio Frequency Anechoic Chamber Facility



Precision Radio Frequency
Anechoic Chamber Facility

FUNCTION: Performs measurements and calibration of antennas for satellites and aircraft or ground-based systems. The chamber is primarily used for optimizing antenna designs, configurations, and performance on satellites and ground planes. It produces 2-D and 3-D antenna patterns and swept VSWR measurements in both hardcopy and softcopy format. An associated program called STK (Satellite Tool Kit) can also be used to analyze the data in a simulated environment, using the measured antenna patterns.

INSTRUMENTATION: Antennas under test receive signals transmitted from the opposite end of the chamber by octave-band source antennas. Synthesizers and amplifiers feed the source antennas. Received signals are routed to an HP8510C network analyzer, where they are processed and sent to the control computer. The Flam and Russell 959 Automated Antenna Measurement System is used to control the HP8510C and the positioners and perform the analysis and plotting.

DESCRIPTION: The Precision Radio Frequency (RF) Anechoic Chamber is a tapered structure, 44 ft long × 14 ft high × 16 ft wide, with a spherical quiet zone 5 ft in diameter. The quiet zone is specified to be isolated from the ambient RF environment outside by 150 dB. The chamber meets the performance specification requirements of free-space voltage-standing wave-radio, axial ratio, and reflectivity over the frequency range of 220 MHz to 40 GHz. Reflectivity levels inside the chamber are less than 50 dB from 1 to 40 GHz. The chamber is instrumented for automated measurement capability.

The chamber is inside a specially constructed electromagnetic interference facility shielded with 1/8-in.-thick steel plate on all walls, floor, and ceiling. This provides 100 dB attenuation to RF signals from 50 MHz to 100 GHz.

CONTACT:
W. Webster • Code 8120 • (202) 404-8272
LOCATION:
Bldg. 68, Rm. 120 • NRL, Washington, DC

Satellite Mission Analysis Facility

Satellite Mission Analysis Facility

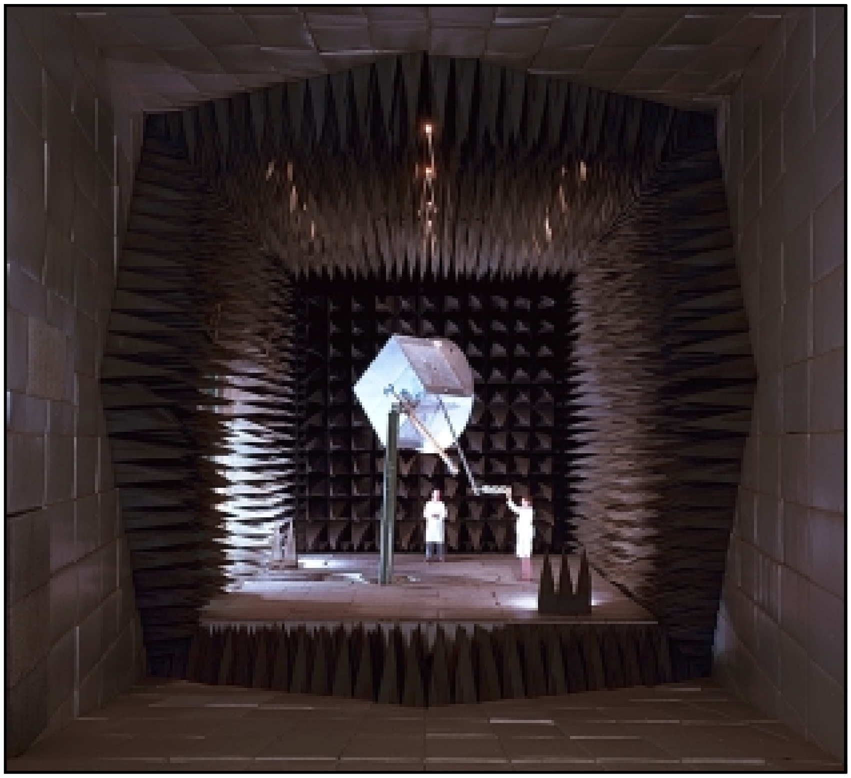
FUNCTION: Compares the on-orbit performance of complex systems against prelaunch and other baseline data. Supports telemetry, tracking, and control (TT&C) and other ground station requirements that cannot be accomplished by established tracking and control networks. The Pomonkey, MD facility can function semi-autonomously since design, fabrication, test, and calibration as well as other support functions are conducted within the facility.

INSTRUMENTATION: The facility maintains an inventory of very low noise front-ends, including special feeds, line elements, and amplifiers. These support the standard UHF, L, S, C, X, Ku, and Ka frequency bands as well as deep space frequency assignments. Operation centers house down-converters and other receiving equipment for signal acquisition within these bands. Special radiometric test equipment is used to verify efficiency, gain, and noise temperature of low-noise, high-gain receiving systems. Vector, scalar, and spectrum analyzers are available to ensure performance of newly developed subsystems and components. Fiber-optic links are widely available in support of high-speed connections.

DESCRIPTION: Pomonkey is a unique field laboratory with associated platforms and located 25 miles south of NRL near LaPlata, MD. The site occupies approximately 58 acres and is owned by NRL. It contains the largest high-speed tracking antenna in the United States and is suitable for low Earth orbit and deep space mission requirements. Other precision tracking antennas are available with apertures ranging from 1 to 9 m. Using special designs, Pomonkey can support operations over a wide band of frequencies from 50 to 25,000 MHz. Real-time signal enhancement and analysis capability has been developed for the facility, and specific operational analysis tools have been implemented to support a wide range of tasks. Operational systems at the facility are linked through several networks in a peer-to-peer environment. A primary network provides access to key systems at NRL and other agencies, while a second network supports operations conducted at the facility. Firewalls and switches protect the integrity of the systems. Precise ephemeris data of all catalogued objects is obtained from the Naval Space Command through automated communications.

CONTACT:
S. John Catania • Code 8124 • (202) 767-1750 or (301) 870-3528
LOCATION:
Pomonkey, MD

Radio Frequency Anechoic Chamber Facility



Radio Frequency Anechoic Chamber Facility

FUNCTION: Supports the design, manufacture, and test of antenna systems. The facility is also used as an electromagnetic compatibility/radio frequency interference (EMC/RFI) test chamber.

INSTRUMENTATION: The chamber is controlled by the SA2095 automatic system. This includes a SA1795 receiver, SA2180 signal source, SA2186 synthesizer, SA1885 position indicator, SA4139 position controller, a Compaq computer, Iomega disk drives, and a HP laser printer. A dual-polarized transmitting antenna is fed by a synthesizer, amplifier, and multiplexer, allowing vertical and horizontal polarization (amplitude and phase) to be taken simultaneously.

DESCRIPTION: The facility consists of a 20-ft EMC shielded room, machine shop tools, and a shielded 120-ft anechoic chamber with an automatic test measurement system. The chamber is 31 × 31 × 120 ft. It is pyramidal in shape and tapers to a conical section at the transmitting end. The back wall of the chamber is covered with 169 absorbing pyramids that are 9 ft. in length. The sides, ceiling, and floor are lined with 4-ft absorbing pyramids. The transition from the 31 × 31-ft test area to the conical end is covered with wedge absorber. In the center of the floor is a 9-ft diameter pit that contains the large model tower. Also in the pit are two scissor lifts that move a section of the floor, so that the tower can be lowered for the mounting of models and antennas at ground level.

CONTACT:
F. Domer • Code 8130.3 • (202) 767-2789
LOCATION:
Bldg. A59, Door A • NRL, Washington, DC

Midway Research Center (MRC) Precision Spacecraft Calibration Facility

Precision Spacecraft Calibration Facility

FUNCTION: The Midway Research Center (MRC) is a worldwide test range that provides accurate, known signals as standards for performance verification, validation, calibration, and anomaly investigation for national missions and other customers. In this role, the MRC ensures the availability of responsive and coordinated scheduling, transmission, measurement, and reporting of accurate and repeatable signals.

INSTRUMENTATION: The MRC system is normally configured to support specific customers; however, the system can be reconfigured in a reasonable time frame to support other needs. The MRC instrumentation suite includes nanosecond-level time reference to USNO, precision frequency standards, accurate RF and microwave power measurement instrumentation, and precision tracking methodologies. The instrumentation has been used for MMW projects. Classified and unclassified projects are supported. There is extensive computer control of all assets. The communications system handles wideband data, both classified and unclassified.

DESCRIPTION: The headquarters and primary site of the MRC is located on 162 acres in Stafford County, VA, contiguous to the Quantico Marine Corps Base. The main site consists of three 18.2-m, radome-enclosed precision tracking antennas and a variety of smaller antennas. The MRC has a large operation building and multiple other equipment and office buildings within a fenced compound. The MRC has the capability to transmit precision test signals, with multiple modulation types, from 20 MHz to 18 GHz (up to 40 GHz in an experimental mode). In addition to the primary site, the MRC is responsible for and controls multiple assets both in the U.S. and overseas. These assets include Pulstar Systems (several worldwide locations), “The Dish” (a 45-m tracking antenna in Palo Alto, CA) and “Marlock” (a 25-m tracking antenna system on Guam).

CONTACT:
D. Penn • Code 8140 • (703) 551-1920

LOCATION:
Midway Research Center • Stafford, VA

Blossom Point Satellite Tracking and Command Station

Blossom Point Satellite Tracking and Command Station

FUNCTION: Provides simultaneous tracking and data acquisition, health and status monitoring, and command and control for NRL and Navy satellites. The site participates in the development of space systems, both satellite and ground elements, to support Navy mission requircments.

INSTRUMENTATION: The facility has five 20-ft parabolic antennas and two 33-ft parabolic antennas. There are eight satellite receive links and seven satellite uplinks. Command, control, and data storage are provided by 8 mainframe computers, 12 X-windows workstations, and approximately 95 Gb of mass storage. Power is supplied by six redundant uninterruptable power supplies (UPSs) with a total rating of 284 kW. Emergency power is supplied by a redundant emergency generator.

DESCRIPTION: The Satellite Tracking and Command Station is located in Blossom Point, MD, in southern Charles County. The facility is contained on 41 acres located within the U.S. Army Research Laboratory's property bordering Nanjemoy Creek and the Potomac River. This location provides horizon-to-horizon look angles and an interference free, low noise environment. To prevent interference with the sensitive satellite antenna radio receivers, the Blossom Point Tracking and Command Station is protected by a 2000-ft-radius buffer zone.

The facility consists of 13 buildings totaling approximately 65,000 ft^2 of floor space that includes approximately 10,000 ft^2 of operational space.

The numerous site antennas receive data from and transmit commands to satellites. The station is in continuous operation 24 hours/day, 7 days/week, and supports 27 spacecraft.

CONTACT:
A. Sharman • Code 8140.5 • (301) 870-3582
LOCATION:
Bldg. 11 • NRL, Blossom Point, MD

Precision Clock Evaluation Facility (PCEF)

Precision Clock Evaluation Facility

FUNCTION: Supports performance evaluation, environmental testing, including shock and vibration and anomaly investigation of on-orbit observed performance of high-precision atomic clocks for spacecraft, ground, and mobile applications.

INSTRUMENTATION: Four data collection systems were built by NRL and are used within the PCEF. The primary atomic clock measurement/data collection system is a 48-channel, dual-mixer phase measurement system capable of simultaneous measurements of 48 different clocks at 20-s intervals indefinitely. A single-channel, dual-mixer phase measurement system used for special evaluations is capable of measurements as short as 0.01 s. These data systems each have 2 ps of resolution. Software used in these systems was designed and coded by NRL, and includes analysis software with graphics and networking support for commercial products.

DESCRIPTION: The PCEF consists of time and frequency reference standards for comparison with test units that are made up of five active hydrogen maser frequency standards, three of which are housed in a large environmental chamber for humidity and temperature control. These references provide uninterrupted precise and accurate time/frequency with a stability of about 1×10^{-15} at 1 day and are maintained in synchronism with UTC (USNO) by several independent means. Eight spacecraft cesium and rubidium atomic, clock-sized thermal vacuum chambers specially designed for short- and long-term testing are used to simulate a spacelike environment ($<1 \times 10^{-6}$ Torr) with temperature control of 0.1° C. To support long-term testing in a space environment, the test chambers and time/frequency standard references are operated on a 125 kW uninterruptible power system with diesel backup. Magnetic sensitivity testing of precision frequency standards is performed with two Helmholtz coil systems; a three-axis multicoil system and a single-axis 1.5-m Helmholtz coil.

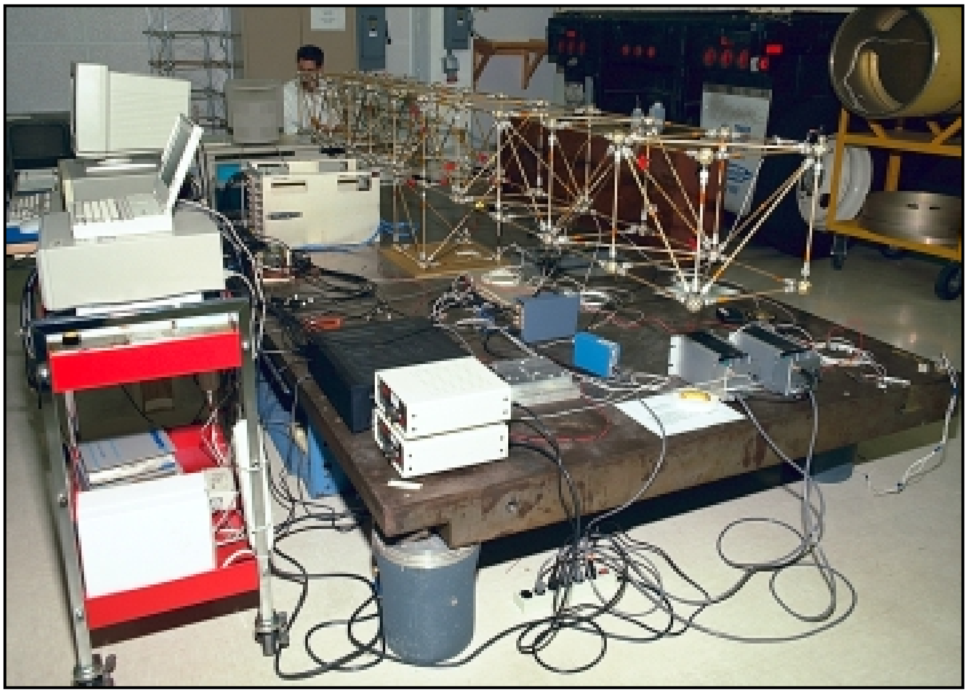
CONTACT:
J. White • Code 8150.1 • (202) 767-5111

LOCATION:
Bldg. 53, Rms. 103, 204, 205, 208, and 217 • NRL, Washington, DC

Spacecraft Engineering Department

- Modal Survey Test Facility
- Static Loads Test Facility
- Spacecraft Vibration Test Facility
- Payload Processing Facility
- Thermal Vacuum Test Facility
- Spacecraft Acoustic Reverberation Chamber Test Facility
- Spacecraft Spin Test Facility
- Reshape Facility
- Spacecraft Thermal Analysis, Fabrication, and Test Facility
- NCST Composite Materials Laboratory
- Spacecraft Robotics Engineering and Controls Laboratory
- Class 100 Clean Room Facility

Modal Survey Test Facility (MSTF)



Modal Survey Test Facility

FUNCTION: Provides the Naval Center for Space Technology (NCST) with the ability to perform modal survey testing on a wide variety of spacecraft and structures. The data acquired from the test enables the structural analyst to determine the dynamic characteristics of the test article. The test results may be used to correlate finite element models.

INSTRUMENTATION: A Hewlett Packard VXI system with 288 channels of data acquisition provides the means for recording forces and acceleration responses during the modal test. A full complement of accelerometers, force transducers, and signal conditioning is available to support tests of all sizes. Results may be directed to SDRC's IDEAS, Matlab, or other programs for final processing.

DESCRIPTION: The MSTF is located wherever the test article can be set up with appropriate boundary conditions. It depends only on sufficient space for mounting the test article and setting up the data acquisition system. The NCST's Environmental Test Facility offers space up to and including a structural test floor large enough to handle Space Shuttle-size payloads. Electromagnetic shakers of 75 and 250 lbf are available to provide excitation for the test.

CONTACT:
R. Haynes • Code 8210 • (202) 767-3944
LOCATION:
Bldg. A59 • NRL, Washington, DC

Static Loads Test Facility (SLTF)

Static Loads Test Facility

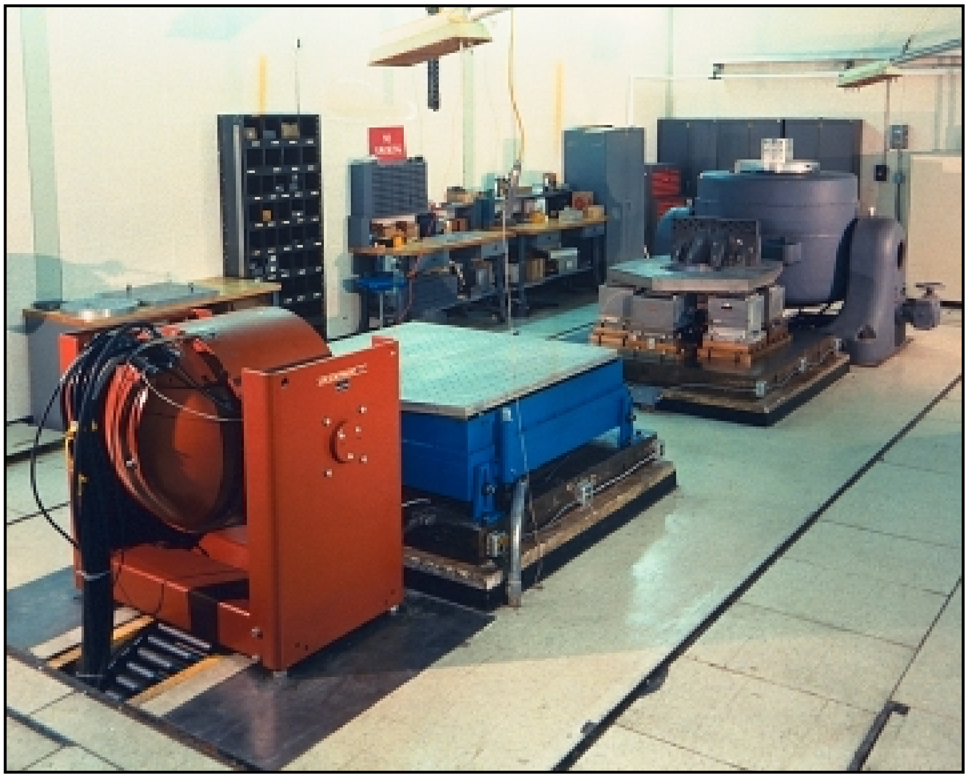
FUNCTION: Provides the Naval Center of Space Technology and the Navy with the capability to perform large-scale structural loads testing on spacecraft and other structures. Results from these tests can be used to verify strength capabilities of the test article.

INSTRUMENTATION: Data acquisition is available for strain gages, linear voltage displacement transducers (LVDT), sonar displacement transducers, and load cells. An OPTUM Megadeck 200 data acquisition system provides capability for collecting up to 400 strain-gage measurements. An OPTUM Megdeck 5733A 72-channel data acquisition system provides high-speed measurement capability. Facilities for light machining are also available. Additional facilities, hardware, and test equipment are available in the Environmental Test Facility to support testing.

DESCRIPTION: The SLTF consists of a 40 × 50-ft structural test floor, a structural steel fixture system, and a computer-controlled hydraulic loads application system. The test floor is located in a high-bay facility complete with an overhead crane. The crane has two carriages with 30,000 lb capacity each and approximately 30 ft of hook height. Areas adjacent to the test floor can be used for test article buildup and for test support activities. The test fixture system is an erector-set concept that allows for a wide variety of configurations to fit specific test needs. The load applications system can support up to 20 independent load strings with force capabilities from 3,000 to 100,000 lb.

CONTACT:
R. Haynes • Code 8210 • (202) 767-3944
LOCATION:
Bldg. A59 • NRL, Washington, DC

Spacecraft Vibration Test Facility



Spacecraft Vibration Test Facility

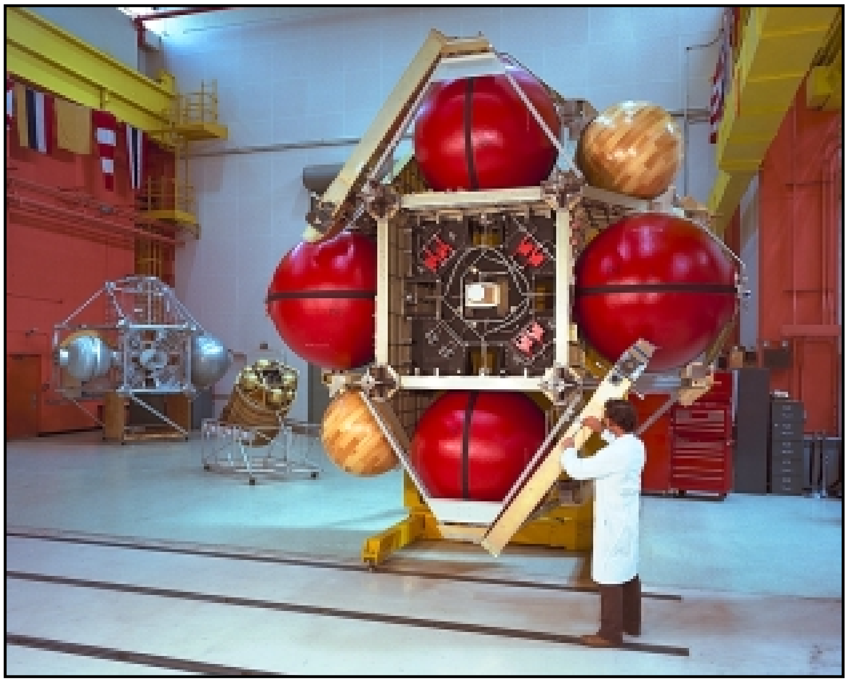
FUNCTION: Qualifies and acceptance tests spacecraft and spaceflight components by simulating the various vibration loading environments present during flight operations and demonstrating compliance to design specifications. Using the facilities electrodynamic shakers, an assortment of quasi-static, vibratory, and shock loads can be generated, and test article characteristics can be quantified.

INSTRUMENTATION: A Spectral Dynamics 2550 provides control and limiting of up to 32 channels of accelerometer response. The facility has the capability to perform digital data acquisition of up to 300 channels using a HP VXI E1432 digitizer with IDEAS postprocessing.

DESCRIPTION: The spacecraft vibration test facility is located within the Payload Processing Facility and consists of four electrodynamic shakers (one 40-klb force, one 30-klb force, two 18-klb force), two slip tables, three individual power amplifiers, and a high-power switching system. The 40-klb and 18-klb shakers have an operational range of 5 to 2000 Hz and 1-in. stroke. The 30-klb shaker has an operational range of 5 to 2000 Hz and 2-in. stroke.

CONTACT:
W. Raynor • Code 8212 • (202) 767-0704
LOCATION:
Bldg. A59, Door I • NRL, Washington, DC

Payload Processing Facility (PPF)



Payload Processing Facility

FUNCTION: Provides a central location for all equipment and auxiliary machinery used to assemble and test space vehicles, subsystems, experiments, and components.

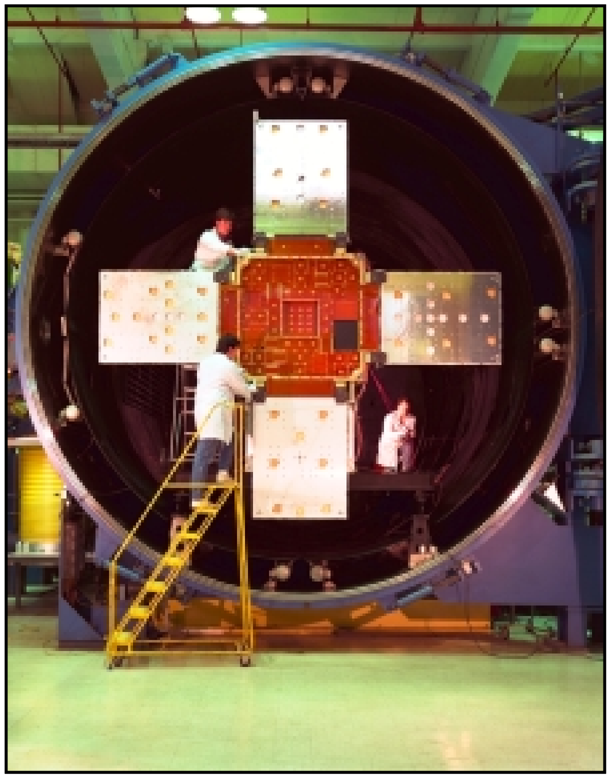
INSTRUMENTATION: The Payload Processing Facility (PPF) has a large array of mechanical aerospace ground equipment (MAGE), electrical aerospace ground equipment (EAGE), and equipment/special test equipment (SE/STE) to support the myriad of tasks that occur during spacecraft assembly. The SE/STE include clean rooms (Class 100 –10,000), large isolated reaction masses, central HVAC/humidity control, liquid nitrogen (LN_2) and GN_2 supply, and extensive electrical power distribution and common grounding for equipment and ordnance.

DESCRIPTION: The PPF consists of a comprehensive laboratory complex housing a high-bay (13,500-ft^2, 40-ft high) assembly area, a secure assembly area (SCIF), support facilities, storage area, lifting equipment, fabrication machinery, and ground transportation equipment. The PPF houses the following environmental test facilities: acoustic reverberation chamber, random vibration, thermal vacuum, EMI/EMC/RF chambers, optical alignment, modal survey, static loads, Spin balance. In addition, the PPF houses the Thermal Control Systems, and Reaction Control Systems assembly and test facilities, Composites Fabrication Lab, and Heat Pipe Lab.

The assembly area serves as the fabrication, assembly, and integration area for spacecraft and flight hardware. Within the assembly area, structural assembly, wire harness assembly, component and subsystem integration, MAGE, and EAGE checkout and debug occur.

CONTACT:
W. Raynor • Code 8212 • (202) 767-0704
LOCATION:
Bldg. A59, Door I • NRL, Washington, DC

Thermal Vacuum Test Facility (TVAC)



Thermal Vacuum Test Facility

FUNCTION: Provides the capability to accurately simulate the space environment for the verification of thermal control system designs and the determination of thermal performance margins and capabilities of space vehicles, experiments, and subsystems.

INSTRUMENTATION: The facility has both computerized and manual control capability of the different chambers thermal environments via the chamber shrouds and/or heaters, cold plates, and quartz lamps. Separate data acquisition systems exist for collection of up to 200 thermocouples, 100 RTDs, QCM, and RGA measurements.

DESCRIPTION: The TVAC test facility is located within the Payload Processing Facility. It consists of three large chambers and several small chambers, a machinery room, a network of computers, 26,000-gal liquid nitrogen (LN_2) storage facility, and an assortment of handling and test fixtures.

Of the three large chambers, chamber #1 is a 16-ft diameter by 30-ft long horizontal end-loading cylinder and chambers #2 and #3 are 7-ft diameter by 8-ft tall vertical bottom-loading cylinders. Chambers #1 and #2 are cryogenic pumped, providing an oil-free vacuum environment. Chamber #3 is a diffusion pump system capable of evacuation rates similar to the rates that occur during launch ascent. All three chambers are equipped with GN_2 conditioned thermal shrouds capable of temperatures between –150° to +125°C. Numerous bulkheads are available for the pass through of control, communication, power, and telemetry signals to the test setup.

CONTACT:
W. Raynor • Code 8212 • (202) 767-0704
LOCATION:
Bldg. A59, Door I • NRL, Washington, DC

Spacecraft Acoustic Reverberation Chamber Test Facility

Spacecraft Acoustic Reverberation Chamber Test Facility

FUNCTION: Provides the capability to simulate the vibration and high-intensity, acoustic noise environment experienced by spaceflight hardware during the launch vehicle ascent.

INSTRUMENTATION: Control of the chamber sound pressure level (SPL) is provided through a Spectral Dynamics 1500 acoustic controller connected to up to 12 microphones suspended within the chamber. For shaker vibration, a Spectral Dynamics 2550 provides control and limiting of up to 32 channels of accelerometer response. The facility has the capability to perform digital data acquisition of up to 300 channels using a HP VXI E1432 digitizer with IDEAS postprocessing.

DESCRIPTION: The acoustic reverberation chamber is located within the Payload Processing Facility and consists of: 10,000-ft^3 test cell (17.2 ft wide, 21.5 ft long, and 27 ft high), 30,000-lb force electrodynamic vibration shaker, machinery room, network of computers and amplifiers, 26,000-gal liquid nitrogen (LN_2) storage facility, and an assortment of handling and test fixtures.

An SPL of 153 dB, with a range of 32 to 10,000 Hz, is attainable in the chamber. The 30,000-lb force shaker has a 2-in. stroke and 2,000 Hz upper limit and is mounted in the center of the chamber floor to provide mechanical vibration excitation in addition to acoustic excitation of test specimens.

CONTACT:
W. Raynor • Code 8212 • (202) 767-0704
LOCATION:
Bldg. A59, Door I • NRL, Washington, DC

Spacecraft Spin Test Facility (SSTF)

Spacecraft Spin Test Facility

FUNCTION: Provides the capability of correcting unbalance of spacecraft by using dynamic measurement techniques and static/coupled measurements to provide products of inertia. Moments of inertia (MOI) can be determined on various capacity MOI tables.

INSTRUMENTATION: The vertical spin machine is a Schenk/Trebel model E-6 hydrostatic bearing spin table, has capacity up to 18,000 lb, spins at rates of 30 to 300 rpm, and is capable of 2 oz/in. accuracy. The horizontal spin machine is a Schenk/Trebel model FH600 horizontal hard bearing spin table, has capacity of 13 to 1,300 lb, spin rates of 50 to 600 rpm, and is capable of 100 moz/in. accuracy. MOI tables include the Space Electronics models GB8000 (capacity of 8,000 lb), and 973-3000 (3,000 lb). Both have an accuracy of ±0.5% of total MOI. We also have Inertia Dynamics MOI tables with 5-, 50-, 100-, 200-lb capacities, with an accuracy of ±0.005% of total MOI.

DESCRIPTION: The facility contains two spin balancing machines (one horizontal and one vertical) to handle the various types of balancing requirements. Both machines are provided with a plane separation network to obtain correction readings directly in the plane of correction. The spin machines require 100 ft^2 of space and are clamped to a slotted 4-ft reinforced concrete floor for stability. Each machine has a remote control console to operate from a distance of 100 ft during hazardous operations. Various capacity moment of inertia tables are used to verify moment of inertia and center of gravity.

CONTACT:
R. Haynes • Code 8212 • (202) 767-0705
LOCATION:
Bldg. A59, Rm. 7E100 (Assembly Area) • NRL, Washington, DC

Reshape Facility

Reshape Facility

FUNCTION: Studies satellite attitude control design and develops methods for jitter suppression of deployed spacecraft sensors, booms, and solar panels. The laboratory also includes a spacecraft boom simulator, the NRL evolutionary truss. The simulator is designed to develop prototype space-capable, deployable structures incorporating attached or embedded sensors and actuators for health monitoring, active structural jitter control, and on-orbit metrology.

INSTRUMENTATION: A data acquisition and control system (DACS) fixed to the platform receives and processes information from the sensors and determines control signals transmitted to the actuators. The system consists of an Austin Computers 486 notebook computer equipped with analog-to-digital and digital-to-analog interface boards with 8 input and 8 output channels. A power system comprised of rechargeable gelled electrolyte cell batteries fixed to the platform provides power to the inertial measurement unit (IMU), reaction wheel/motor assemblies (RWAs), and DACS. An RF system transmits data from the onboard control system to a ground computer. The system uses ARLAN capable of transferring data at 19.2 kbits/s.

DESCRIPTION: The Reconfigurable Spacecraft Host for Attitude and Pointing Experiments (RESHAPE) facility includes a control test-bed supported by a spherical air-bearing platform with three frictionless rotational degrees of freedom: ±30° about the horizontal axes and ±360° about the vertical axis. The maximum load capacity is 2500 lb at an air pressure of 169 psi. A circular test platform affixed to the air-bearing ball provides a mounting surface for the various subsystems of the simulated spacecraft bus as well as payloads. An IMU fixed to the platform provides attitude and rate information. The unit consists of two 2°-of-freedom tuned rotor gyros with a resolution of better than 0.05°/hour. Three mutually orthogonal 0.5 ft-lb RWA fixed to the platform provide three-axis stabilization and control. Additional instrumentation includes a massive, pneumatically isolated test table, modal test data acquisition system, and high-speed digital control system.

CONTACT:
M. Brown • Code 8220 • (202) 767-2851
LOCATION:
Bldg. A59, Rm. 7E100 • NRL, Washington, DC

Spacecraft Thermal Analysis, Fabrication, and Test Facility

Spacecraft Thermal Analysis, Fabrication,and Test Facility

FUNCTION: Provides for the analytical thermal design and analysis of any spacecraft, including conceptual design, analytical thermal model development, definition of requirements, worst-case environments and design conditions, and temperature predictions for all cases. The facility provides, for any spacecraft, the means to turn an "analytical thermal design" into a working temperature control subsystem ready for flight (i.e., provides the means to go from design and analysis to hardware qualification and acceptance testing and then to orbit).

INSTRUMENTATION: A computerized data acquisition and control system (CDACS) is used during thermal testing for the display, collection, storage, and retrieval of temperature and power data, and for the automated control of all power supplies that feed various simulation heaters. CDACS consists of:

- two workstations with displays
- signal conditioners for over 1,000 thermo-couple and low-voltage inputs
- 40 rack-mounted, digital power supplies with appropriate bus connectivity for output control.

DESCRIPTION: This facility provides computer support to accommodate six thermal analysts. The software required to create and run analytical thermal models include radiation exchange and orbital flux determination, TRASYS/TSS; and thermal model formation and temperature prediction, SINDA. Thermo-optical surface properties of "real" surfaces must be known accurately for reliable temperature prediction. Thus, two types of reflectometers are used to measure short wavelengths for solar absorptions and long-wave infrared for room-temperature emittance. Detail thermal design and analysis is followed by fabrication and test phases. Capabilities within the facility include fabrication, assembly and qualification of flight hardware, and flight support. Technicians have expertise in the manipulation of all contemporary and advanced thermal control hardware including, but not limited to:

- multilayer insulation materials (for thermal blankets)
- flight-qualified temperature sensors, thermostats, heaters.

This facility is capable of and has supported the incorporation of specialty technologies such as:

- cryogenic thermal blankets and cryo coolers
- diode, loop, constant and variable conductance heat pipes
- Capillary pumped loops and other advanced two-phase systems.

CONTACT:
R. Baldauff • Code 8221 • (202) 404-7432
LOCATION:
Bldg. A59 • NRL, Washington, DC

NCST Composite Materials Laboratory

NCST Composite Materials Laboratory

FUNCTION: Designs, fabricates, tests, and flies spaceflight articles that use composite materials and smart structures. It has a variety of equipment and experienced personnel for support of composites research and fabrication for the Naval Center for Space Technology (NCST) and NRL.

DESCRIPTION: The Composites Laboratory gives access to a wide variety of test and integration facilities in addition to the manufacturing capabilities that it comprises.

INSTRUMENTATION: Autoclaves with computer-controlled cure and data logging:

- large—flight part production and prototyping; size: 6-ft diameter, 10-ft length chamber, 650 F max, 300 psi max
- smaller—laboratory development prototyping; size: 1.5-ft diameter, 3-ft length chamber, 850 F max, 300 psi max
- vacuum bag integrity check with ultrasonic leak detector
- NDE: Panametrics Epoch III-B Ultrasonic Flaw Detector
- thermocouples, strain gages, and accelerometers
- freezer storage for prepregs and adhesives.

CONTACT:
W. Pogue • Code 8222 • (202) 404-1731
LOCATION:
Bldg. A59, Door I • NRL, Washington, DC

Spacecraft Robotics Engineering and Controls Laboratory

Spacecraft Robotics Engineering and Controls Laboratory

FUNCTION: Serves as a national testbed to support research in the emerging field of space robotics including autonomous rendezvous and capture, remote assembly operations, and machine learning.

INSTRUMENTATION: Dynamic Motion Simulator, with dual independent six-degree-of-freedom (DOF) platforms, provides the ability to test space robotic systems under realistic dynamic and lighting conditions.

DESCRIPTION: Operated by the Naval Center for Space Technology, with strategic support from the Naval Center for Applied Research in Artificial Intelligence, this is the largest dual-platform motion simulator of its kind. It allows full-scale hardware-in-the-loop testing of flight mechanisms, sensors, and logic of space robotic systems. The simulator also supports the study of other complex relative motion problems.

Spacecraft orbit parameters, mass properties, and actuators are modeled in the central computer to enable the simulator to replicate vehicle motion response to external disturbances and internal orientation and position commands. Actuator signals normally going to wheels or thrusters are continually processed to compute incremental force and torque components that force the platform to respond dynamically as a spacecraft would on-orbit.

CONTACT:
G. Creamer • Code 8231 • (202) 404-3530
LOCATION:
Bldg. A59 • NRL, Washington, DC

Class 100 Clean Room Facility

Class 100 Clean Room Facility

FUNCTION: Provides a Class 100 ultraclean environment for the cleaning, assembly, and acceptance testing of contamination-sensitive spacecraft components and integration of complete spacecraft subsystems. The facility is used primarily to support spacecraft propulsion systems but has been used to support all spacecraft electrical, electronic, and mechanical subsystems.

INSTRUMENTATION: The clean rooms are supported by an extensive array of special test equipment (STE) to support the needs of contamination-controlled testing and integration of spaceflight hardware. This STE consists of ultrasonic cleaning equipment, particle counting stations, water purification stations, vacuum drying stations, immersion flush stations, test hardware, electrical checkout stations, rinse stations, inert gas purges, DC power supplies, tooling and fixtures, and high- and low-pressure test panels for helium and nitrogen test gases.

DESCRIPTION: The facility consists of two self-contained rooms that have a footprint of 44 × 43 × 13 ft and an additional area for mechanical equipment that covers an area 43 × 20 × 13 ft, for a total volume of 35,776 ft^3. The entire work area is airtight; pressurized; and dust, temperature, and humidity controlled. It has two laminar flow rooms with an air velocity across the entire room of 100 to 120 ft/min. The air is filtered by using HEPA filters to an absolute level of 0.3 m. The rooms are environmentally controlled using air conditioning to achieve 65° to 75°F and 40% to 60% relative humidity. The rooms are maintained at a minimum 0.15 in. of water pressure differential with existing atmospheric conditions.

CONTACT:
A. Kudlach • Code 8232 • (202) 767-9172
LOCATION:
Bldg. A59, Rm. 3E100 • NRL, Washington, DC

GENERAL INFORMATION

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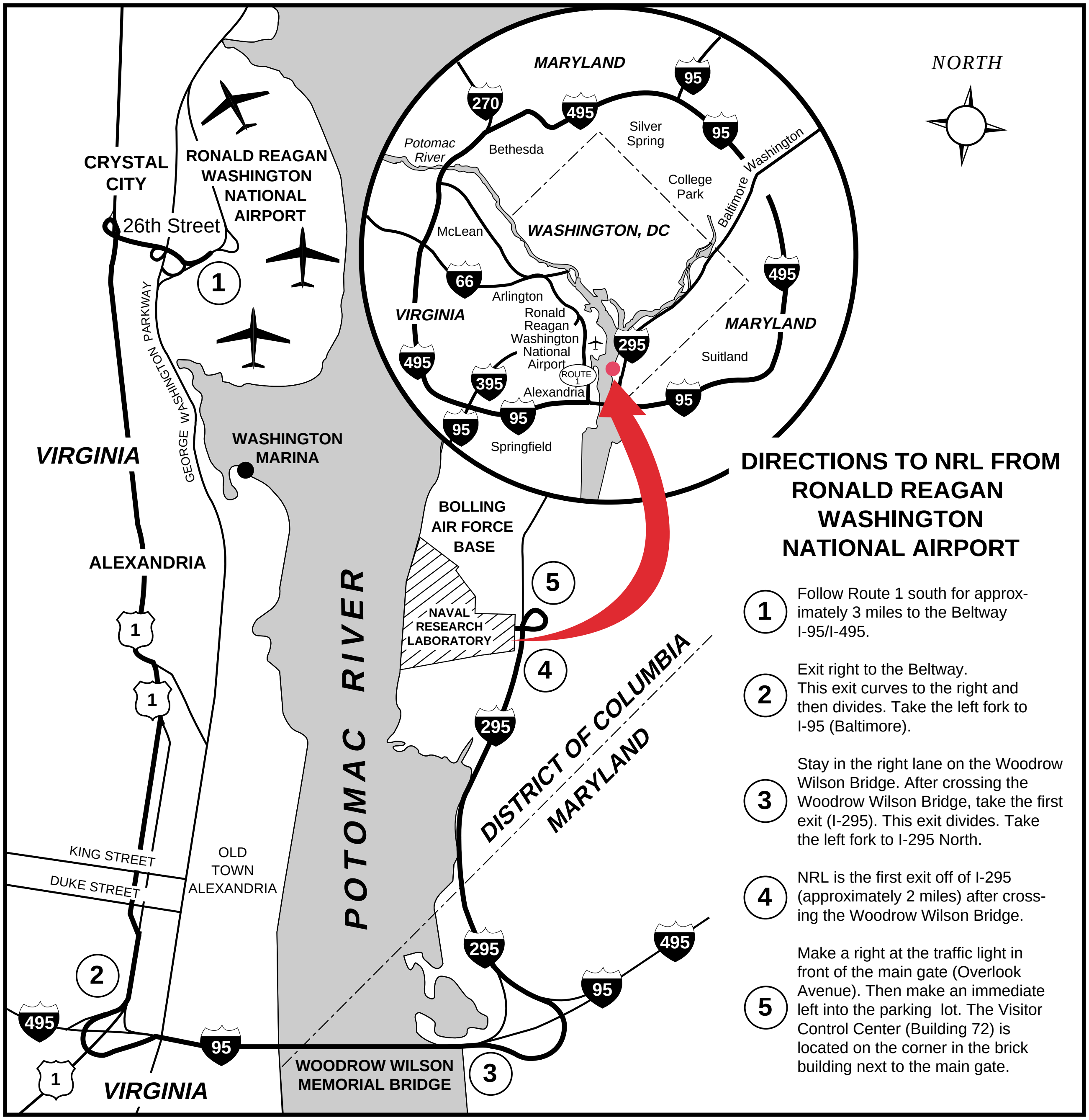
- John C. Stennis Space Center (Stennis Space Center, MS)
- Naval Research Laboratory Monterey (Monterey, CA)
- Key Personnel

Naval Research Laboratory (Washington, DC)

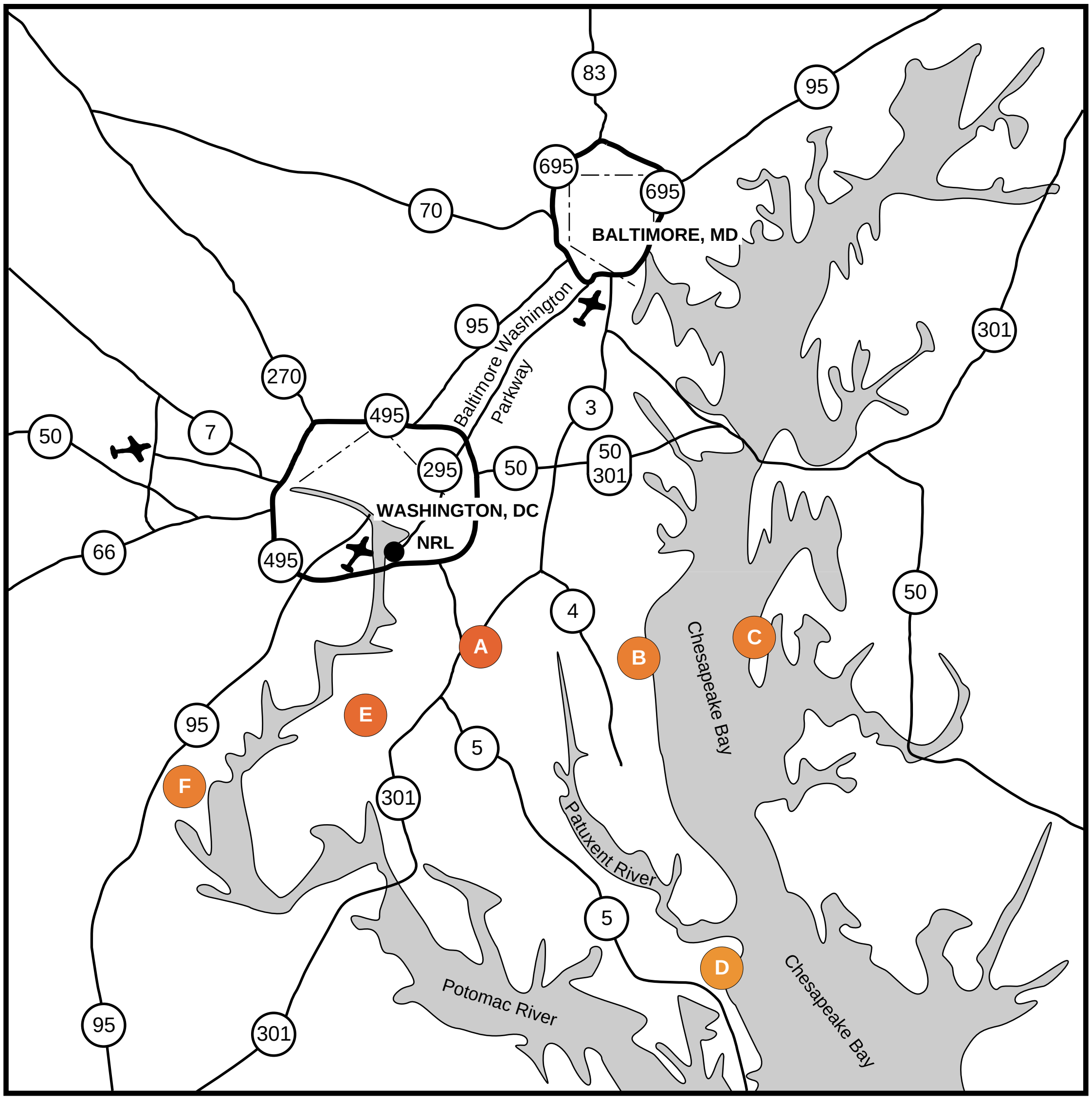


DIRECTIONS TO NRL FROM RONALD REAGAN WASHINGTON NATIONAL AIRPORT

1. Follow Route 1 south for approximately 3 miles to the Beltway I-95/I-495.
2. Exit right to the Beltway. This exit curves to the right and then divides. Take the left fork to I-95 (Baltimore).
3. Stay in the right lane on the Woodrow Wilson Bridge. After crossing the Woodrow Wilson Bridge, take the first exit (I-295). This exit divides. Take the left fork to I-295 North.
4. NRL is the first exit off of I-295 (approximately 2 miles) after crossing the Woodrow Wilson Bridge.
5. Make a right at the traffic light in front of the main gate (Overlook Avenue). Then make an immediate left into the parking lot. The Visitor Control Center (Building 72) is located on the corner in the brick building next to the main gate.

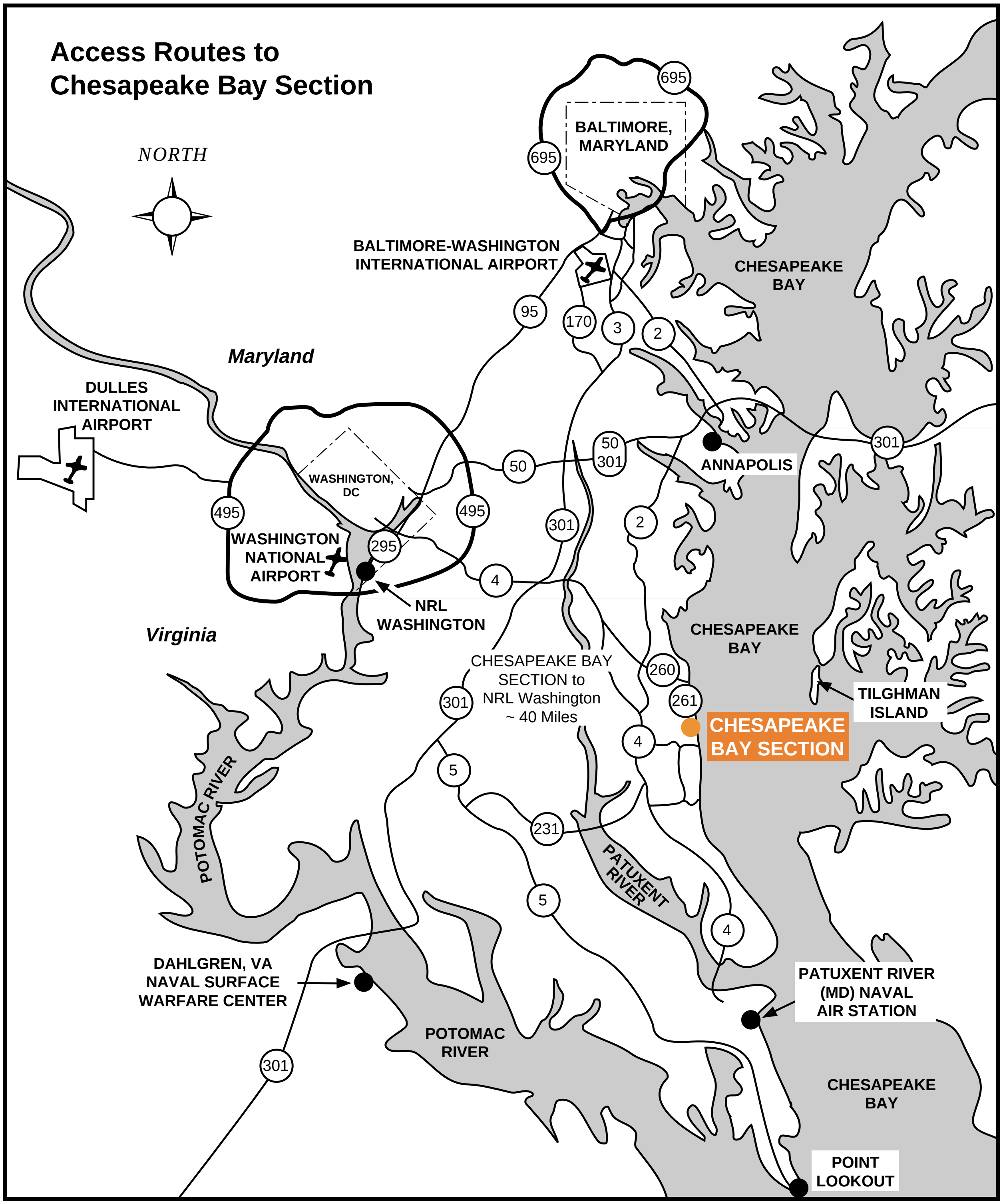
Naval Research Laboratory
4555 Overlook Avenue, SW
Washington, DC 20375-5320
(202) 767-3200

Location of Field Sites in the NRL Washington Area



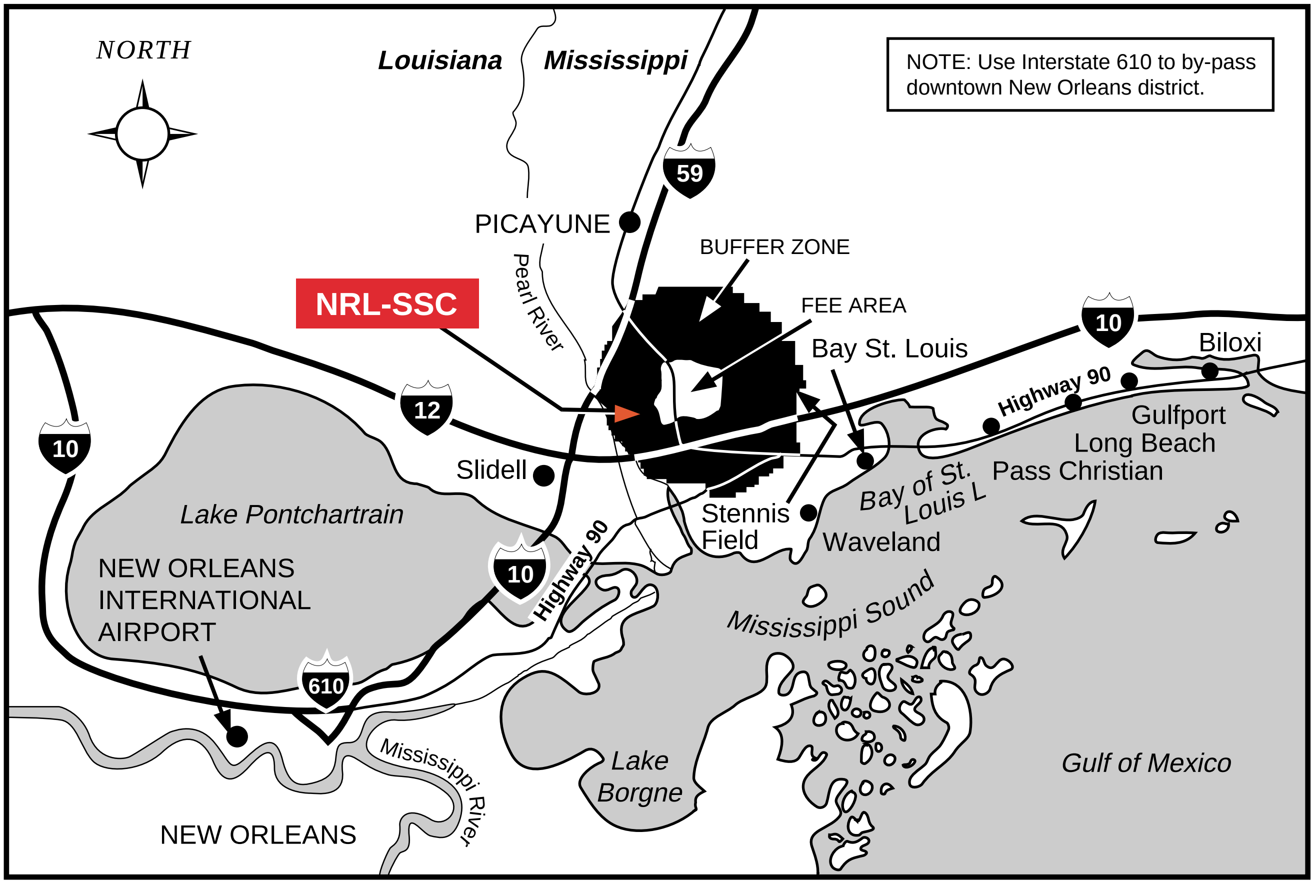
Location	Approximate Mileage from NRL Washington	Cognizant Code
A — Brandywine, MD	28	5500
B — Chesapeake Bay Section, Chesapeake Beach, MD	40	3522
C — Tilghman Island, MD	110	3522
D — Patuxent River (MD) Naval Air Station	64	1600
E — Pomonkey, MD	20	8106
F — Midway Research Center, Quantico, VA	38	8140

Chesapeake Bay Section (Chesapeake Beach, Maryland)



Naval Research Laboratory
Chesapeake Bay Section
5813 Bayside Road
Chesapeake Beach, MD 20732
(301) 257-4002

John C. Stennis Space Center
(Stennis Space Center, Mississippi)



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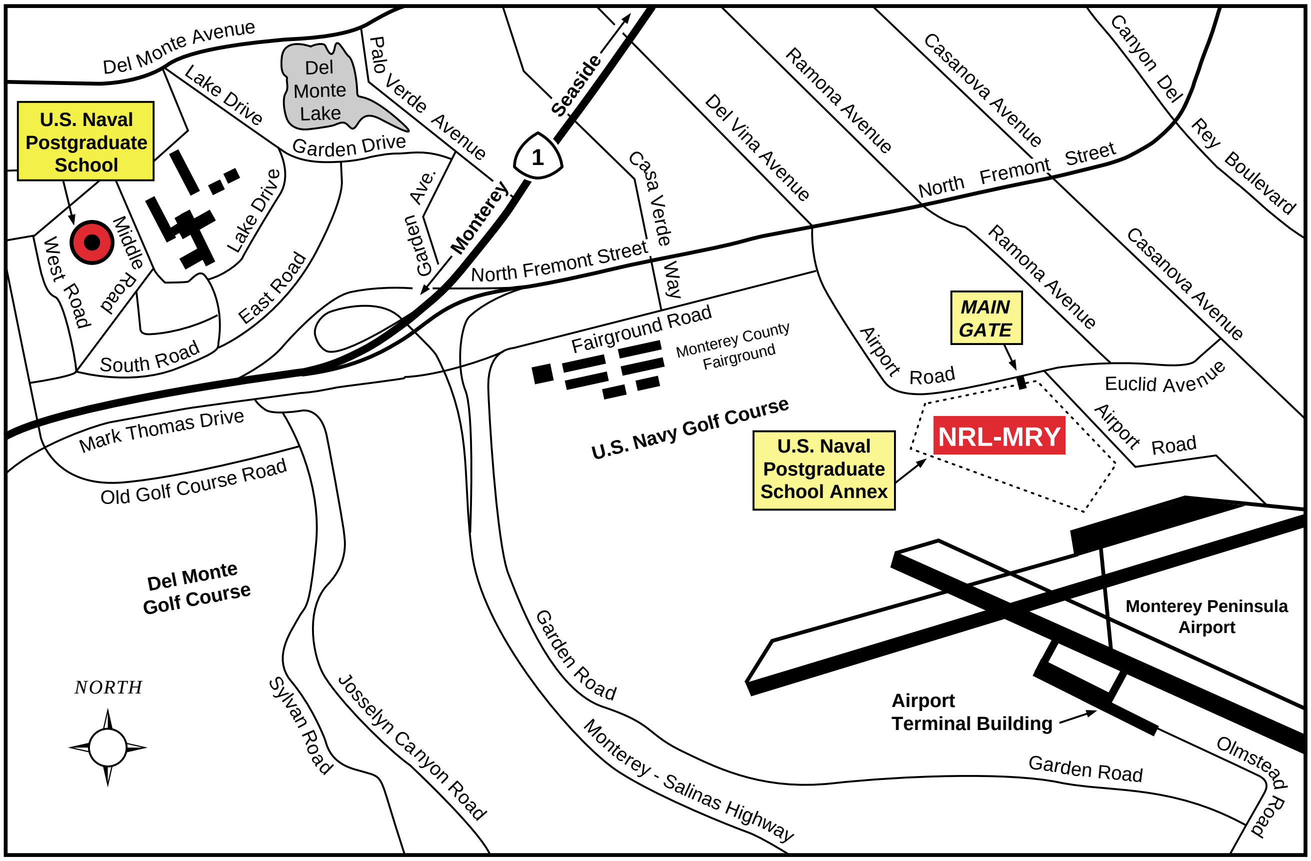
Stennis Space Center, MS 39529-5004
(228) 688-3390

Naval Research Laboratory Monterey (Monterey, California)



Naval Research Laboratory
Marine Meteorology Division
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DSN-297 or 754

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